S. HRG. 103-528

IMPLEMENTATION OF THE CLIMATE CHANGE ACTION PLAN

HEARING

BEFORE THE

SUBCOMMITTEE ON
CLEAN AIR AND NUCLEAR REGULATION

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

APRIL 14, 1994

Printed for the use of the Committee on Environment and Public Works

U.S. GOVERNMENT PRINTING OFFICE

78-531 mc WASHINGTON : 1994

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-044779-8

S. HRG. 103–528

IMPLEMENTATION OF THE CLIMATE CHANGE ACTION PLAN

tation of the Climate Chang...

...EARING

BEFORE THE

SUBCOMMITTEE ON
CLEAN AIR AND NUCLEAR REGULATION

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

APRIL 14, 1994

Printed for the use of the Committee on Environment and Public Works

U.S. GOVERNMENT PRINTING OFFICE
78–531 mc WASHINGTON : 1994

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-044779-8

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

MAX BAUCUS, Montana, *Chairman*

DANIEL PATRICK MOYNIHAN, New York
GEORGE J. MITCHELL, Maine
FRANK R. LAUTENBERG, New Jersey
HARRY REID, Nevada
BOB GRAHAM, Florida
JOSEPH I. LIEBERMAN, Connecticut
HOWARD M. METZENBAUM, Ohio
HARRIS WOFFORD, Pennsylvania
BARBARA BOXER, California

JOHN H. CHAFEE, Rhode Island
ALAN K. SIMPSON, Wyoming
DAVE DURENBERGER, Minnesota
JOHN W. WARNER, Virginia
ROBERT SMITH, New Hampshire
LAUCH FAIRCLOTH, North Carolina
DIRK KEMPTHORNE, Idaho

PETER L. SCHER, *Staff Director*
STEVEN J. SHIMBERG, *Minority Staff Director and Chief Counsel*

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR REGULATION

JOSEPH I. LIEBERMAN, Connecticut, *Chairman*

DANIEL PATRICK MOYNIHAN, New York
BOB GRAHAM, Florida
HOWARD M. METZENBAUM, Ohio

ALAN K. SIMPSON, Wyoming
LAUCH FAIRCLOTH, North Carolina
DIRK KEMPTHORNE, Idaho

CONTENTS

OPENING STATEMENT

WITNESSES

ADDITIONAL MATERIAL

IMPLEMENTATION OF THE CLIMATE CHANGE ACTION PLAN

THURSDAY, APRIL 14, 1994

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR REGULATION,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:36 a.m. in room SD–406, Dirksen Senate Office Building, Hon. Joseph I. Lieberman [chairman of the subcommittee] presiding.

Present: Senators Lieberman and Faircloth.

OPENING STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Senator LIEBERMAN. Good morning, and welcome to this subcommittee hearing. Last October, when we first had discussion about the President's Global Climate Change Plan, I expressed cautious optimism about the plan, which is designed to reduce greenhouse gas emissions by the year 2000 to 1990 levels. I had one concern about the plan which was that it contained neither interim milestones nor a system for measuring those milestones so that we do not arrive at the year 2000 and find that we are way behind President Clinton's commitment to the Nation and to the world community.

I said at the committee's October hearing that I would be calling EPA and DOE back in 6 months to determine if progress had been made in this area, and thanks to an extraordinarily efficient and time sensitive staff, we have managed to achieve that here this morning. And I thank the witnesses for being here.

The administration's testimony today indicates that significant steps have been taken in meeting the concerns that were expressed in October. The Department of Energy and the Environmental Protection Agency I think do an excellent job in their testimony of asking the right questions for determining whether the plan will be successful. And those questions include: what if the plan has only limited success in achieving the objectives of reducing greenhouse gas emissions and saving energy; how can we determine which of the plans 46 actions reduce emissions most effectively; can they be expanded; should those that yield lower than expected savings be continued; can they be improved.

But while these questions are the right ones, I am concerned that the approach to providing clear answers to those questions is not as much in place as I think it ought to be. There is no substitute for an annual system of measurement, monitoring and

tracking of greenhouse gas reductions from each strategy. The degree of market place success of the technologies or strategies in the plan, the degree of client satisfaction and favorable public opinion, while useful, cannot serve as a substitute for actual measurement of energy savings and emissions reductions.

Many of the items in the climate change plan are frankly unproven with respect to their ability to achieve emission reductions. I think it is therefore very important that the success or failure of these actions be measurable. These measurements are important so that we can ensure that successful technologies or strategies are expanded and unsuccessful programs are eliminated. I hope to hear more from the administration this morning on this point. How will we ensure that resources are allocated to those programs which are achieving maximum emissions reductions. Programs with appropriations obviously develop constituencies that advocate for those appropriations. Will it be easy to abandon a technology or a strategy that has developed a constituency. Information about reductions from individual action items must be accompanied by data on national progress in reducing the inventory of greenhouse gas emissions. I am pleased that the administration will testify today about the system for monitoring and tracking the national inventory that it has developed.

My concern about some of these questions I've raised is heightened; while I applaud the administration for the forward steps it has taken, pathbreaking steps dealing with the reality of global climate change which have not been taken by previous administrations, the plan itself—and I think we've got to be frank to acknowledge—in terms of its actual impact, should be described as an important, but ultimately first and modest step.

In this regard, I would say that I'm troubled by recent information from the Energy Information Administration which apparently shows that by the end of 1993 energy related carbon emissions had reached a level that the administration had not anticipated in its calculations until around 1996. I'm not saying this is bad faith by the administration, it is simply that the carbon emissions have risen more rapidly than was foreseen. And that would raise serious questions about whether stabilization of emissions can be achieved by the year 2000. Second, even if greenhouse gases throughout the world are frozen at 1990 levels today—let's assume that they could be frozen at those levels today—constant annual emissions will still increase the total concentration of greenhouse gases and the heat trapping capacity of the atmosphere.

In other words, stabilizing emissions is quite different from stabilizing atmospheric concentrations. The International Panel on Climate Change, which is the international relevant group that represents 50 countries, concluded that stabilizing greenhouse gases in the atmosphere at today's level would require up to an 80 percent reduction in carbon dioxide emissions immediately and significant reductions in other greenhouse gases. According to the Congressional Office of Technology Assessment, unless the global climate change models that we are all dealing with now are seriously flawed, average temperatures are expected to increase approximately five degrees fahrenheit over the next century, even under the most optimistic emission reductions scenarios.

So to sum it up, it seems to me that there is increasing scientific evidence that I am sure we will hear today that global climate change is occurring. This is real; this is not the stuff of science fiction or a bunch of air headed alarmists, this is documented. And what we are attempting to do to cut down emissions, as significant as those steps are, nonetheless are just the beginning of what we are going to have to do to deal with this problem.

And that is why OTA representatives and some of the scientists we will hear today will tell us that even if the plan that the administration has put forth is successful, we are going to have to cope with the consequences of global climate change. That is, we are not really stopping the process at this point. And those consequences will include rising sea levels, the possibility of more frequent and/or more intense coastal storms, recurring periods of temperature variability and droughts, changes in water supplies, disruption of ecosystems, and changes in many other climate-sensitive natural resources.

The fact is that global sea level has risen 4 to 8 inches in the past hundred years. OTA reports that a best estimate of future sea level rise due to global warming is 26 inches above levels that would have otherwise existed by the year 2100. So we have 4 to 8 inches increase in sea level over the last hundred years, and an estimate from our own Office of Technology Assessment, of 26 inches more in essentially the next hundred years. If no action is taken to protect against this rise, according to OTA, up to 5,000 square miles of dry land, and an additional 4,000 square miles of wetlands, could be inundated, including portions of such coastal cities as Atlantic City, Ocean City, Charleston and Miami Beach.

Just to bring it home to Connecticut, sea level rises of this magnitude along the Connecticut coast would result in total inundation or significant landward moving of barrier beaches such as Hammonasset Beach, which is probably our most popular State park beach in Connecticut, and destruction of some coastal property. It would also result in more damaging flooding along the tidal Connecticut River and more of wetlands.

OTA argues that the virtual inevitability of climate change and the magnitude of the potential effects of climate change requires us to take mitigation steps. We are going to hear about some of those recommendations today. But while it is appropriate to consider mitigation measures, the OTA work also makes clear that we must make sure that the actions we are taking to reduce the impact of climate change are as effective as possible. And it is with that goal in mind that this Subcommittee will continue its oversight of the plan's implementation.

I am delighted now to welcome the witnesses. On the first panel I'll list them and then call on them. First is Honorable Robert Sussman, Deputy Administrator of U.S. EPA; Honorable Susan Tierney, Assistant Secretary for Policy, Planning and Program Evaluation at DOE, and the Honorable Christine Ervin, Assistant Secretary Energy Efficiency and Renewable Energy, of the U.S. Department of Energy. And Bob, I see you are accompanied by a familiar figure who you may also wish to introduce. Welcome and we look forward to your testimony.

STATEMENT OF HON. ROBERT M. SUSSMAN, DEPUTY ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY DAVID GARDNER, ASSISTANT ADMINISTRATOR FOR POLICY AND PLANNING

Mr. SUSSMAN. Thank you very much. I will introduce this familiar figure on my right who is David Gardner, our Assistant Administrator for Policy, Planning and Evaluation, and a critical player in our climate change effort, who supports me and others very effectively. I am happy to have you here.

Thank you, Mr. Chairman, for the opportunity to discuss EPA's implementation of the Climate Change Action Plan. When the President released the Plan, he stated that it is "the most aggressive and the most specific first step that any nation on this planet has taken in the face of perhaps the biggest environmental threat to the planet." The President committed his Administration to periodically evaluate the emission trends and program effectiveness and to pursue additional policy initiatives if the trends indicate that our progress is insufficient to obtain our goal. Since the President announced the Plan 6 months ago, our Agency has focused on establishing programs to reduce greenhouse gas emissions as quickly and efficiently as possible. An integral part of this effort has been the establishment of simple, clear indicators of progress for plan implementation.

Our Agency, and the Department of Energy, co-lead an interagency effort to track progress of the Climate Change Action Plan. We have established a three-part framework to evaluate progress towards our national goals. First, EPA works with the Department of Energy Information Agency and the Department of Agriculture to develop and update inventories of emissions of greenhouse gases nationally.

But the national inventory is too general to rely on for detailed evaluation and finetuning of Action Plan activities. For that reason, the second part of our framework consists of the goals that we at EPA have established for each element of the plan for which we are responsible and the related indicators of progress we have put in place to gauge the extent to which our initiatives are on track.

The third element of the framework we have put in place in cooperation with the Department of Energy is an effort to update and evaluate the relationship between what I might call the micro-level effects of individual actions, and the macro-level effects demonstrated in trends in the national emissions inventory. Bridging the gap between the two will allow us to better determine the overall effectiveness of the Plan, to target improvements in program activities to obtain the most cost effective emission reductions, and to guide development of later plans.

Let me comment more fully on some of the program indicators and milestones that we are putting in place for the initiatives that we at EPA are implementing. By December of 1993 we at EPA had established specific program indicators and milestones in a standard format to track our progress in implementing the Action Plan and in reducing emissions of greenhouse gases.

I would like to share with you, Mr. Chairman, and I believe we previously shared with your staff, a summary of the current indicators and milestones. This summary reflects our current best esti-

mates of the accomplishments we intend to achieve. EPA will gather information on each indicator on a regular basis for some programs as frequently as quarterly. We expect to periodically revise our procedures and indicators as we learn through experience how to better evaluate and run programs. In developing the indicators and milestones, we have made an effort to choose measures which are quantifiable and, to the extent possible, linked in a clear manner to emissions reductions.

I want to stress that our milestones and indicators of progress are still evolving. We have more work to do in this area and we will be doing it in the weeks and months ahead.

Here is a sample of the measures and milestones we track on a regular basis. Each quarter, our Green Lights Program reports the number of new participants, the square footage of buildings recruited into the program, the square footage surveyed and upgraded, as well as an estimate of the number of pounds of CO_2 emissions prevented per year as a result of the implemented upgrades and lighting efficiency. By May of this year, we expect to have recruited more than 175 partners in our Energy Star Region and by September, we expect to have recruited 150 hospitals and 140 universities, colleges and schools. By the end of the year, we expect to have at least 2,000 total Green Lights Program participants.

Although we will have indicators of success and milestones for EPA programs, we need to go beyond these milestones and indicators, as I stressed before, to assess the aggregate results of the Climate Change Action Plan in reducing greenhouse gas emissions. This does require that we pursue all three elements of the framework that I described earlier.

I would like to talk about the third step, which I think is in some ways the most challenging and the most difficult, which involves bridging the gap between our indicators of progress and milestones for specific initiatives in our national emissions inventory, which will be prepared on an annual basis. This requires us to evaluate not just our progress in implementing the Plan, but changes in factors in the great world beyond the Federal government, such as economic growth and energy prices and overall consequent trends in energy utilization. This is an effort which our Agency is going to tackle along with the Department of Energy. We are going to co-lead an interagency process. And our charge will be to revise projections of program achievements and continually assess the amounts by which we believe the Action Plan is reducing emissions and also continually assess how close we are to our target for 2000. If further action is warranted as a result of this assessment, we will obviously have to consider modifications to our Plan.

Let me say that we take very seriously our commitment to the world to reduce greenhouse gases, as established in the Framework Convention on Climate Change. We have taken the lead, not just to declare policy, but to implement effective programs to meet this goal. I know that some concern has been expressed that recent economic and energy market conditions would make it more difficult to reach the 1990 target level by the year 2000 under the Plan as currently structured. While this Plan was predicated on assumptions about the future, about the impact of our programs, it was

also designed to be responsive and adaptable to changing circumstances. Specifically, we said 6 months ago that we would periodically assess and review our progress, and we also said that if we had to we would make mid-course corrections and change the Plan. I should caution though that in conducting this review we need to be very careful to differentiate short term fluctuations in economic conditions, energy consumption and energy prices from changes in long term trends. This is not an easy line to draw, but we have to be careful, I think, not to react too quickly to fluctuations and conditions which may turn out to be very limited in duration, as opposed to longer term trends which we do have to take seriously and respond to.

For this reason, we are now currently assessing the implications of recent shifts in market conditions on our forecast levels of emissions. At the same time, we need to commit our resources in energy to implementing the ambitious slate of programs that we have committed to undertake. So we need to move forward on two tracks; one, we need to implement the programs that we have committed to; two, we need to be alert to the larger environment in which we are functioning, we need to examine trends, and we also need to remain alert to the need for mid-course corrections if conditions point us in the direction.

We welcome feedback from the Congress on how we might better design and evaluate our programs. And I should say that we also welcome, and I should emphasize need, the support of the Congress for full funding of the package of initiatives that we plan to implement in fiscal year 1995. Full funding of the Climate Change Action Plan is absolutely essential if we are to meet our year 2000 targets. And for that reason, let me strongly urge that Congress support our EPA fiscal year 1995 budget request of approximately $107 million and 153 FTE for climate change implementation activity. Thank you.

Senator LIEBERMAN. Thank you, Mr. Sussman for your testimony. I was just thinking as you were talking about not overacting to short developments, but considering them in the context of the long term trends, I think that is important to say that I have had more than one person ask me whether global climate change is really occurring when one considers the winter we went through and how could the planet be warming if we had all that snow. I am advised by my scientific counselors that this was a short term and regional trend and does not disrupt the unfortunate scientific evidence that the planet is warming and the seas are rising.

I would like to come back, Bob, and talk to you some more about this question of measurements. I appreciate what you have said about your openness to devising systems for accurate measurement of actual emissions reduction that is occurring, so that as you carry out your expressed policy of openness to making mid-course corrections, that you and we have adequate data to do that.

I also appreciate what you said at the beginning in quoting the President. The Plan is a significant plan, and I'll ask later about how it does compare, but I gather it compares favorably to efforts being made by other countries. The problem obviously is the significance of the change that is occurring, but in a political context, the difficulty of convincing people that we have to take steps that

are inconvenient, costly to try to avoid a problem whose consequences will not be fully felt for decades, and that makes leadership difficult. But since there seems to be a growing consensus that this problem is actually occurring, we have to do our best to head it off. Anyway I appreciate your testimony and your effort in that regard.

Ms. Tierney?

STATEMENT OF HON. SUSAN TIERNEY, ASSISTANT SECRETARY, POLICY, PLANNING AND PROGRAM EVALUATION, DEPARTMENT OF ENERGY

Ms. TIERNEY. Thank you, Mr. Chairman. I must start by saying that I know the Department of Energy is very pleased with the oversight role that you are continuing to provide in this area. We really do welcome the spotlight on our Global Climate Change Action strategy, because we think we have very good news to tell with regard to carefully planning out a course——

Senator LIEBERMAN. These are very directional microphones, so the closer you are to them the better.

Ms. TIERNEY. Should I start over?

Senator LIEBERMAN. Well, I heard you, but since you had such nice things to say about the Committee, you might as well start over.

[Laughter.]

Ms. TIERNEY. I want to start by saying——

Senator LIEBERMAN. I have a feeling everybody heard. Thanks.

Ms. TIERNEY. —how much we do appreciate the oversight role that this Committee is playing. As you know, the Administration is committed, not only to reducing greenhouse gases, but to do so in a way that enjoys the spotlight of public attention. The role that you are playing today, and that we are joining you in, we think is a very positive public role.

We came here before you 6 months ago and told you about our commitments and our actions and our strategies, and promised to develop the milestones and metrics that we are pleased to talk to you about today. We are not done with the job of putting all of those things in place, but we think we have done an incredible effort in the last 6 months.

Mr. Sussman has talked to you about the collaborative approach that we have developed across the agencies, and I am here with Christine Ervin to talk to you about certain milestones and metrics from our point of view at the Department of Energy. It is part of the same story that Mr. Sussman has described.

I am going to talk about milestones, and by that I mean the milestones that we are putting in place with regard to policy initiatives that were announced. Ms. Ervin will talk to you about a number of the actual metrics and program designs that we have for the over 25 programs that we are implementing at the Department of Energy.

So let me talk to you about what I am calling milestones, which are indicators by which observers can gauge our progress in moving forward on our strategy. Let me start by telling you about a small one that, I hope is not frivolous. Next week, as you know, the White House is holding a conference on climate change action. That

will be accompanied by a number of events on Earth Day relating to global climate change. You have been invited to attend these conferences and I want to also reiterate an invitation we have sent to celebrate our climate challenge program on Wednesday evening at which we expect to sign an agreement with utility companies as part of the overall climate change strategy. We hope that we will have a lot of people to help celebrate those events with us next week.

Let me talk to you more soberly about three areas of milestones; one, data, and data collection procedures; two, long-term domestic policy initiatives that are part of the overall strategy; and three, some international activities that we have going on.

On our data strategy, I want to submit in the record our technical supplement that was published about a month ago. This is a supplement in which we describe in detail, in excruciating, I wouldn't call it mind-bending detail, but a lot of detail with regard to how we developed our plan. This is to create a further spotlight on what we did. It describes the assumptions that we used in projecting how much we think emissions would rise without our plan, and the assumptions associated with the effects of the plan's 50 programs on reducing greenhouse gas emissions.

This document enables observers to analyze the guts of what we have done. It provides a tracking mechanism by which you can see year to year expectations of growth of emissions and the reduction associated with individual programs and clusters of programs where there are synergistic effects. We think this is a very important milestone in making our project transparent.

A second data activity is one that was anticipated with the foresight of Congress in the Energy Policy Act, when the Section 1605(b) data base was authorized. We are well on our way to developing the guidelines under which utilities and other entities would submit data voluntarily into this data base in which we could create an inventory of greenhouse gas emissions reductions and actions associated with them.

This is a voluntary reporting system, as you know. We had a number of workshops in which we heard opinions about various attributes of this data base. We expect to finalize that data base by the end of this fiscal year and have it ready to operate.

With regard to our long-term domestic policy initiatives that are not programs specifically being implemented today by the EPA and by DOE, let me comment on several things. The Climate Action Plan anticipated that the White House would operate two long-term policy development initiatives. One of them would be to engage in an examination of what were appropriate policies for curbing greenhouse gas emissions in the post-2000 period. That process is under development; it has not begun formally, but we are well on the way to shaping what that will look like.

Another White House directed project is one that is farther along, and today, I think today, is being announced in the Federal Register. I can't testify as to this particular notice because I tried to find a copy this morning but didn't. We are announcing a personal motor vehicle transportation task force or advisory committee. This is an advisory committee that we want to advise us with regard to appropriate policies for curbing the rise in greenhouse

gas emissions in the personal motor vehicle sector. As many commentors, and we ourselves, have observed, the motor vehicle sector is an area that we could not attack with gusto in our pre-2000 plan because of a number of things associated with lead times, associated with changing automobiles. We announced in the Plan that we would have a dialogue for building consensus on what are appropriate policy tools for curbing greenhouse gas emissions rise in that sector. That project is now commencing in full and we really look forward to hearing ideas and trying to build some consensus on the way to go there.

With regard to another aspect of policy, that being joint implementation, we have a number of things underway to report to you on. As you know, our Climate Action Plan devised a pilot plan as the way in which the U.S. would gather experience on joint implementation strategies. That pilot plan has been published for comment by the State Department. The State Department has received a rich set of comments on how to actually carry out that pilot strategy. We hope very soon to actually finalize the proposal, and by very soon I mean hopefully within this month, and actually begin to have projects underway. In that vein, the Secretary of Energy is at this moment, if it is about 10:30, announcing a project with the Center for Clean Air Policy, a project in the Czech Republic in which a number of U.S. companies are offering funds to help a Czech city reduce its ground level and greenhouse gas emissions and energy supplies.

Two other things; first, legislative initiatives, and then budget issues on the domestic policy strategies. There were two legislative initiatives in the Climate Action Plan. One of them was the parking "cash-out". We expect to file legislation, I think very shortly, before the summer, and we are in negotiations within the Administration about what the actual details of a number of features of that would be.

With regard to the Hydro-electric Investment Bill, we expect to file a bill by the end of June with the Congress. We have held a number of workshops in which we have tried to learn from various groups opinions about how to structure that. We expect to have some changes from the original proposal that will enable a win-win situation to come before the Congress.

On budget, let me mention that we have submitted to the Congress a fiscal year 1995 budget that we believe fully enables the Department of Energy to move forward on its greenhouse gas reduction programs. We need all the help we can get in ensuring that that budget is passed because without it, it will make it very difficult to accomplish that purpose.

The Department of Energy's climate budget totals about $280 million for both energy efficiency and renewable, as well as fossil programs. That budget was guided by a Department of Energy effort to do a strategic planning exercise. We have commented on our strategic planning results. We have copies of the Plan here with us today. The thing I want to say about it is that we believe we have a way of viewing our energy policy development in a way that is aligned with environmental goals for the country, and we are very pleased to present that as well.

Finally, on the international front, let me just mention that the Administration has been quite active in the international negotiations on the Framework Convention on Climate Change. As you know, that convention went into force last month and we have been negotiating with the parties about what the international communications that are due this fall will need to contain with regard to data, and what would be allowed with regard to programs. We believe that the U.S. strategy that includes sinks and all greenhouse gases is being embraced by other countries, so we are pleased with the progress of those negotiations.

With that, again, I thank you. I look forward to your comments and I know that Christine Ervin will talk to you about a number of our programs.

Senator LIEBERMAN. Great, thank you, Ms. Tierney.

Ms. Ervin, welcome.

STATEMENT OF HON. CHRISTINE ERVIN, ASSISTANT SECRETARY, ENERGY EFFICIENCY AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Ms. ERVIN. Thank you, Mr. Chairman. I am very pleased to appear before you to give you the details of and to report on the great progress that we are making in designing and beginning to implement elements of the President's Climate Change Action Plan. Before I start I would also like to introduce Dr. Peter Fox Penner, who is sitting behind me, he is my principal deputy and has played a lead role in designing and shaping the climate change programs that we have in my office.

Assistant Secretary Tierney described the continuing progress in the broad policy areas of climate change. As she indicated, I will turn attention now to the program design and implementation details.

In the Office of Energy Efficiency and Renewable Energy we have direct responsibility to implement almost half of the climate plan, 21 out of the 46 total actions. All in all, our fiscal year 1995 budget includes $191 million for those programs spread across two appropriation subcommittees. Now these plans range all the way from helping states to design and implement building codes in the residential and commercial sector, to helping industries simultaneously reduce their energy costs and reduce the generation of pollution, to actions to boost the commercialization of renewable resource technologies for our markets here and overseas. It is a package of plans that I think is going to reap great benefits for this country not only in terms of stabilizing greenhouse emissions, but in terms of jobs and strengthening our economy.

With the announcement of the President's Climate Change Action Plan we, as Sue indicated, went into high gear. We had a lot of work to do to mobilize a lot of different resources in our office. The goals we set for ourselves are detailed in my written comments, but let me highlight them quickly.

The goals we had were designed to do a number of things; one, obviously to deliver the emissions reductions; two, to follow the action areas set forth in the Plan and build in specific milestones and metrics to keep the programs on track; and three, to aggressively

implement the authority granted us under the Energy Policy Act of 1992.

We didn't want to reinvent the wheel and we wanted to incorporate existing programs and build on existing infrastructure wherever we could. We also wanted to leverage resources by creating very innovative partnerships with State and local governments, with regulators, with industry, and with energy service companies and utilities. And then we wanted to apply the principles of reinventing government by involving all those stakeholders at the very front end of program design and incorporate in their considerations from the start. What that means is a vigorous, time intensive process in program design, but one that I am convinced results in much better designed, efficient and effective programs, and a better represented constituency.

To date, we have accomplished the following: we have established a planning center which we are actually calling the "Green Room" in the Forrestal Building. Through this facility, program managers share information on a routine basis about the plan initiatives. They meet there to coordinate with each other because, of course, they are located in many different program offices. They brainstorm, create solutions, seek input from industry, regulators, and local government representatives. State energy offices have loaned personnel to help us work in the Green Room, leveraging additional resources. This co-location, has been remarkably successful in helping us foster the coordination, of all the resources that we need to bring to bear in this effort.

Working together with representatives of our constituencies, we have crafted a 400 page set of implementation plans; one for each action under our jurisdiction, complete with milestones and evaluation metrics. We've already provided copies of those action plans to staff of this committee. I am pleased to deliver additional copies today. Here is an example of what that set looks like.

To further increase stakeholder involvement, we are also taking these plans on the road. We want to get views of people outside the beltway. We are hosting a series of workshops around the country in places such as Seattle, Denver, Chicago, Atlanta, Boston, and Philadelphia, because we know that accomplishing the objectives of the Plan will require input from a lot of different people in a lot of different places. The response has been excellent so far. We are getting useful feedback.

The invitation extended to the Department by this Committee asked several specific questions. I wanted to address two before I close. First, you asked what milestones have been established to determine whether the Plan's targets for each action item are being met. As I said, each of our plans features a detailed step-by-step set of milestones for the first year of implementation, and then tentative milestones for the years beyond. I'll give you one example, action number four, which is essentially a "golden carrot" program, if you have heard that terminology, to accelerate the deployment of advanced technologies for buildings. Now in that plan we've got a whole series of milestones with a few examples. We've got targeted deadlines with specific dates to complete, for example, the confirmation of the key manufacturers that we are going to need; to analyze the technology and the market options; dates to identify

initial deployment areas; to arrange technology demonstrations if needed; to create buyer groups, and so forth, all of which lead to the production and marketing of these more energy technologies.

Of course, the most important milestone, which has been alluded to and directly said in a number of cases already, is going to be the progress we make in receiving full funding of the fiscal year 1995 budget for the Climate Change Action Plan, and of course, we are watching that milestone very carefully.

The second question that you raised is what is the role of States and localities in implementing the plan. States and localities are critical partners for us. They don't only have good ideas, but they are close to the ground in running and designing programs. We need their input, we need their resources, we need them to implement our programs. Though each action is structured differently, the role of State or local partners will take one or more of three forms. For each action, State and local partners have had the opportunity to participate in the program design, as I mentioned. Many of the programs rely on the States to actually administer the program, for example, revolving funds for building retrofits. They can also participate as full partners in public/private industry collaboratives and they may compete for federal leveraging funds made available through these programs.

That concludes my verbal comments. I welcome any questions you might have.

Senator LIEBERMAN. Thank you, Ms. Ervin. We all agree up here that we can't wait for the movie version of the Green Room, and I would be eager to see who plays Bob Sussman's role in that film. [Laughter.]

Mr. SUSSMAN. I was hoping to play myself.

Senator LIEBERMAN. Oh, you were, okay. That's a recent trend, as Senator Simpson can tell you, who has appeared in at least one feature length movie. People do sometimes play themselves.

I appreciate the report that you have given and it is clear that a lot is going on here. And I want to come back and say to you, Ms. Tierney, thank you for your acknowledgement of what the Subcommittee is trying to do here. I would return that by complimenting you and the EPA and the Administration for the programs that are planned, for instance, next week and beyond.

Part of the problem here, just to come at what I said a few moments ago in a slightly different direction, we are facing an onslaught of immediate public policy problems here in Congress, and the American public is facing those also. We have crime, we have job problems, we have health care reform, welfare reform, I could go on and on. It is quite easy for this problem, which is more insidious and more subtle and longer term, to get lost. And yet it is quite significant and it is important for all of us to try to keep coming back to it and doing two things to it; one, obviously, to create the public understanding and support for the changes that are necessary to deal with to hopefully impede global climate change. And if not impede it adequately, then at least to prepare to deal with the consequences such as rising sea level, as we will discuss in the second panel. And then the second part, of course, is to make sure we are doing everything we can to achieve the reductions.

Let me just deal for a moment with this question of the milestones or measurements, and I understand the difficulty of this. My basic point here is that I think it is going to be important to have standards which really put in your hand and ours, verifiable annual measurements of the reductions in greenhouse gases that have been achieved and the energy that is saved. So I greatly appreciate some of the measurements you have described, the increasing numbers of companies coming in to the Green Lights Program, the deadlines and goals. But what I am pushing, is really the question of how many of the actions in the Plan will have clear measurements in hand of greenhouse gas reductions achieved and energy saved.

Mr. SUSSMAN. I think we need those measurements. Each of these initiatives that we have included in the Plan is accompanied by targets of emission reductions, very specific targets for tons of CO_2 and other greenhouse gas emission reductions that we hope to achieve by the year 2000. And as we go down the road towards the year 2000 we need to evaluate our progress, and that means that we have to have some type of periodic assessment of the effectiveness of our programs, not simply getting to people to sign up, not simply getting people to commit to participate, but to produce actual tonnage reduction. So we need to be able to monitor that. I will say that for some of our programs that is easier than for others.

Senator LIEBERMAN. Talk about that a little. I mean, obviously, the more companies you sign up the more we are going to achieve, but it is a problem of feasibility of achieving those measurements, or is it, for instance, a lot of the programs are voluntary and therefore it is awkward or difficult to impose a tighter measurement standard.

Mr. SUSSMAN. Well, we think that even for the voluntary programs it is entirely appropriate and indeed necessary to ask our partners to submit reports to us. And that's what we are doing in the Green Lights Program where we have put in place reporting mechanisms which I think are quite detailed and are going to give us a lot of specific information about what each of our partners is doing and when they are doing it. In fact, I would say Green Lights is an example of the type of reporting that we should try to have across the board, wherein all of our partners are reporting to us the number of square feet that they have upgraded, the type of lighting that they are replacing, and the type of efficient lighting that they are installing as part of their commitment under the program.

We also have data within EPA about the performance efficiency of the old lighting which is being removed and the new lighting which is being installed, and we can relate those measurements of increasing efficiency to emissions reductions. So in the case of Green Lights, we know the square feet that are being upgraded, we know the types of energy efficient lighting that are being installed, we know the value of that lighting in reducing emissions. And I think we can assemble a very good composite portrait which will enable us to benchmark our progress for that program and achieve emissions reductions.

That to me is the model that we should strive to have across the board. I can be honest in telling you that for some of our programs we are further along than for others, and I think the effort that I would expect to see within our agency over the next few months is one of upgrading and strengthening our indicators of progress and our milestones, so that across the board, we can relate the indicators of progress that we have on the one hand, to emission reductions that we are achieving on an interim.

Senator LIEBERMAN. Okay. Either of the representatives of DOE? Thanks, Bob.

Ms. TIERNEY. Let me add to what Bob said by characterizing the nature of the beast that we have here. Out in the real world what produces emissions or reduces emissions, are for example, things associated with burning fuel at powerplants. Our programs are very many steps removed from that. Even when we have the best information, very accurate information about how many partners signed up for one of the other programs, what they did in their establishments for lights, heating systems, etc. The effects of burning of fuel depends upon a lot of things; what time of the day they actually reduce their electricity use, compared to what would have been burned at that hour of the day. There is inherent in this task an estimation component that we have to do, even when we have fantastic data on who did what at firms and households or in State building codes. There always is going to be an analytic or estimation portion of this that we will need to do as part of what we've laid out as our structure of making a connection between the outcomes as we see them in the real world, as characterized in that inventory that DOE and EPA are jointly doing, and what we do in the specific programs.

Our job as we go forward is to periodically make the crosswalk between what we observe in the real world and the effects associated with our many programs. Our programs give us enormous data, rich data, to see whether or not what we think we are doing is actually moving forward on those. We still will have to estimate the effect on burning things and that's part of what we have as our methodology of moving forward.

Senator LIEBERMAN. Okay, I appreciate the answer. And again, some of the programs that you are implementing—Green Lights is a great program, as is the Climate Challenge program and these agreements that you are negotiating with utilities. I gather you are up to around 80 now for reduction of greenhouse emissions by those utilities to 1990 levels by the year 2000. Those are significant steps forward and we just want to make sure that we have a system in place to measure those and keep us informed about how we are doing so we don't get to the year 2000 and find that we are behind where we hoped to be, which is not as far as we would like to be in the first place.

We haven't asked the question, and I am not going to ask it at any length, but I assume we will begin with the baseline conclusion that global climate change is a problem. Bob, you quoted from the President at the outset, saying it may be the most significant environmental problem we are facing. I take it there are no objections to that conclusion, right?

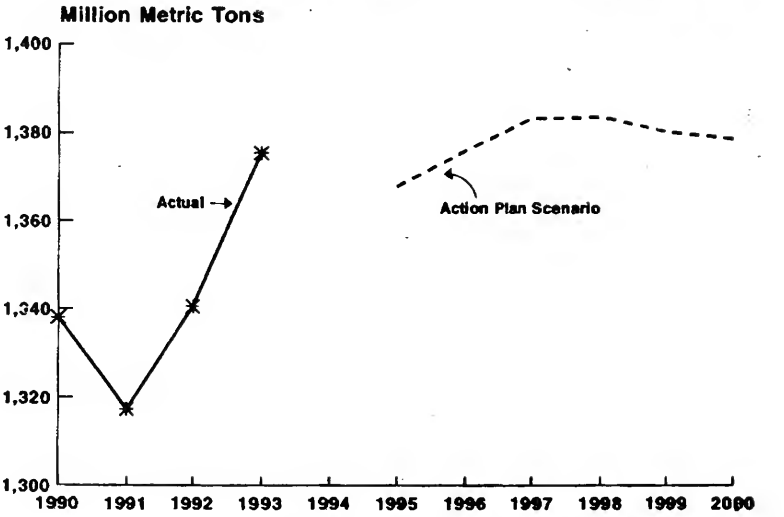
Ms. TIERNEY. We all concur.

Senator LIEBERMAN. Right. I mention the Energy Information Administration report that indicates that 1993 levels of energy sector carbon emissions are greater than anticipated in the calculations for the Plan, which were reasonable calculations when made, and this increase is due to increased economic growth and some other factors. Do you have any more information on that? And as information like that becomes available, is there a process for feeding it into the Plan and altering the Plan?

Ms. Tierney.

Ms. TIERNEY. Perhaps I should begin and then ask my colleagues to join in if there is something I forget to say. We certainly do chart and analyze the relationship between what we expected to occur in any year under the Plan, and what we are actually seeing in the EIA inventory. I have a chart that I would be pleased to submit for the record. I have only one chart at the moment, and I regret that, and I will just describe it briefly and then bring it forward.

Energy Sector Carbon Emissions



Source: EIA, Monthly Energy Review, April 1994; and
Climate Change Action Plan: Technical Supplement, March 1994

Ms. TIERNEY. The chart provides projections of energy-related carbon emissions under the Climate Change Action Plan beginning in 1995 together with actual emissions trends from 1990 through 1993. The substantial year-to-year variation in annual emissions between 1990 and 1993 reflects both economic conditions and weather fluctuations, the latter of which significantly affects the amount of energy used for space conditioning purposes. While the Action Plan does not include explicit emissions values for years prior to 1995, emissions in 1991 and 1992 were below the linear trend connecting the 1990 actual and 1995 projected emissions.

The forecast of the growth in emissions that we observed or estimated in our plan is shown on this chart. And like all forecasts, it represents a smooth curve, that is the emissions output in all years. And the smooth curve is associated with the character of all forecasts, which is to look at trends, based on historical trends for the most part. As Mr. Sussman testified, short term variations off of a trend, and what matters is to see whether or not the actual is really consistently deviating over time from the expected smooth curve, or whether or not over time it begins to kind of bounce around that curve.

It is hard to say based on 2 years of data whether or not we see changes that are long-term variations, because while this year is above what we expected to occur, the previous year was below what we expected to occur. And I will show you this chart. We would be happy to explain in detail the reasons we see for both of those effects in each year.

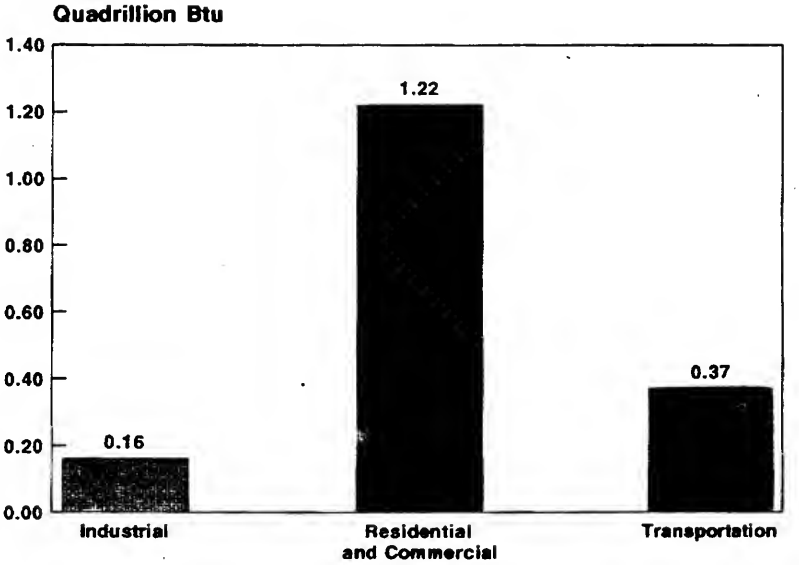
Senator LIEBERMAN. You said the year before was below your projection and 1993 was above. So you are watching it to see whether this is a trend.

Ms. TIERNEY. We think about half of the effect was due to weather conditions in 1993. Some of the effect was associated with economic changes and some of the effect was associated with more travel than we expected to occur. But we would be happy to submit a supplement to the record to explain that.

[The material referred to follows:]

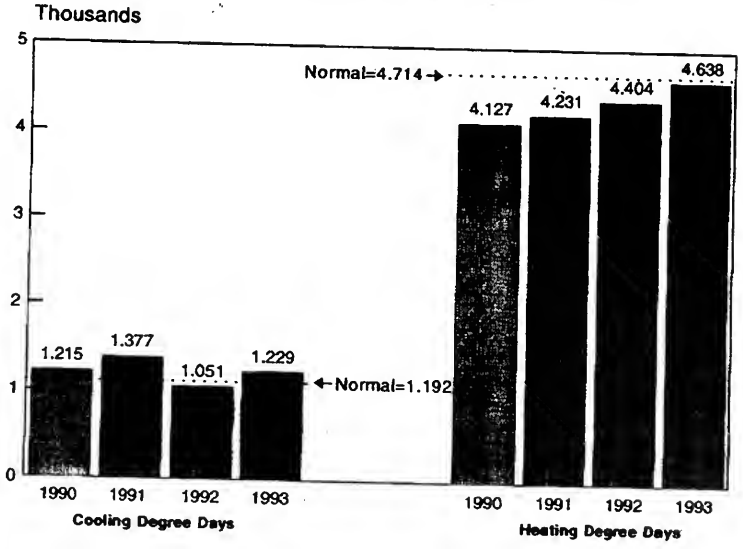
The preliminary sectoral breakdown of changes in energy use between 1992 and 1993 (chart 2) shows that the residential and commercial sectors account for the majority of the increase in overall energy use. We estimate that the rise in both heating and cooling degree-days from their 1992 levels (chart 3) accounts for over two-thirds of the increase in carbon emissions resulting from increased energy use in this sector, and almost half of the total increase in energy-related carbon emissions between 1992 and 1993. Chart 4 provides additional information on the impact of controlling for weather fluctuations in the calculation of energy-related carbon emissions in 1990 and 2000.

Changes in Primary Energy Consumption by Sector
1993 vs. 1992



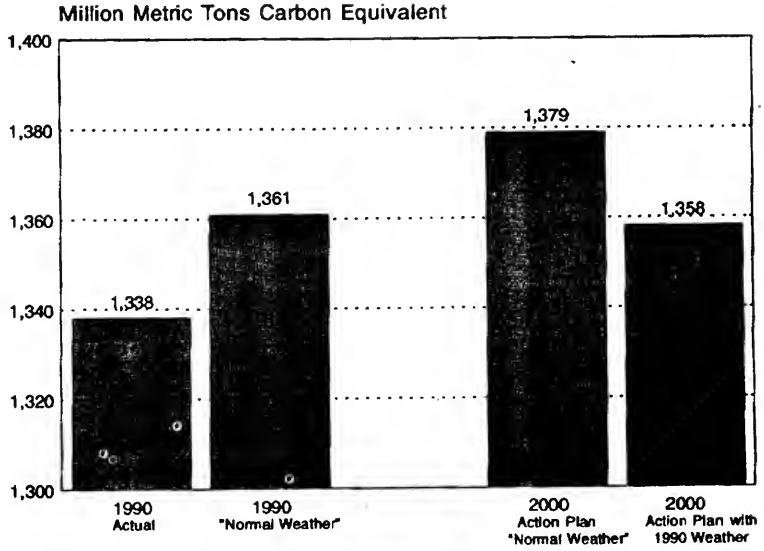
Source: EIA, Monthly Energy Review, April 1994

Heating and Cooling Degree Days
1990 to 1993



Source: EIA, Monthly Energy Review, various editions

Effect of Weather on Carbon Emissions
1990 and 2000



Source: DOE, Office of Economic Analysis and Competition, unpublished estimates

Senator LIEBERMAN. Okay. Let me ask a final question. I see my colleague, Senator Faircloth, is here. Since we are talking about global climate change, not American climate change, we are taking some steps forward here, but what is the general reaction of other countries, both industrialized and industrializing—Western Europe, Japan and then also the rising nations like China, India. How are we doing globally?

Mr. SUSSMAN. Well, we are making progress. We need to continue to make progress. And I think in that regard the United States can play a very critical leadership role, hopefully one which will be constructive and not antagonistic. As I talk to my counterparts in other nations, my impression is that things are happening, particularly in the G–7 nations, the OECD member nations where plans are being developed, the issue is receiving a lot of attention. And I am also seeing that there is great interest in the U.S. approach and people around the world are impressed that we have stepped up to the mark, and intrigued by and prepared to emulate some of the approaches that we are following.

As you know, economic conditions in the developing world are not good right now and that I think has distracted some of our trading partners from focusing on climate change. But I do have the sense that the wheels are turning. We are coming up on some critical milestones which we need to focus on carefully. In September of this year, the signatories to the convention will be required to submit their national plans to the Conference of the Parties and it will be very interesting and very important to see what those plans are like.

In anticipation of that event, we have sponsored a process within the OECD to develop a uniform format for submitting information about the plans so that we do in fact have a good basis for comparison and we can make some informed judgments about whether the plans are adequate or inadequate. But I think a lot will happen over the next couple of years. I am guardedly optimistic that we will see some real progress, but we need to continue to exercise leadership. But I think we need to continue to focus the attention of the developing world and the industrialized world on the importance of this problem.

To get the attention of the developing world, we are pursuing the country studies program. This is a program which EPA and DOE are involved in. It is designed to bring developing countries along the path of dealing with global climate change by building expertise, introducing energy efficient technology, and also raising the general level of awareness about climate change as an environmental problem.

Ms. TIERNEY. Could I add briefly—about 2 weeks ago the Energy Information Administration produced a report on exactly the point you raise in your question, which is what is happening differently in the developed countries as opposed to the developing countries with regard to greenhouse gas emissions growth. The numbers are stark in terms of the growth rates in the developed countries, which are today maybe on the order of magnitude of 1 or 2 percent a year growth in emissions reductions that would occur if commitments were not in place to reduce them. That contrasts with about 10 to 15 percent a year growth rates for the developing countries.

I can't remember the exact figure, and that's why I give you a range. I will submit those numbers for the record.

[The information referred to follows:]

Between 1970 and 1992, energy-related carbon emissions from countries in the Organization for Economic Cooperation and Development (OECD), a key block of the major market-oriented economies, grew 28 percent. Over the same period of time, energy-related carbon emissions in the non-OECD countries grew 82 percent (a 2.8 percent growth rate per year). Thus, carbon emissions from non-OECD countries grew nearly three times as much as carbon emissions from OECD countries between 1970 and 1992. Although energy-related carbon emissions grew rapidly throughout the non-OECD countries during the 1970's and 1980's, the majority of growth in non-OECD carbon emissions during this period was accounted for by the so-called "economies in the transition" (mainly the former Soviet Union, Eastern Europe, and China). Since the late 1990's, however, carbon emissions from "economies in transition" have fallen due to a severe economic downturn in the former Soviet Union and Eastern Europe.

In 1970, total world energy-related carbon emissions were 3,953 million metric tons, of which 1,700 (43 percent) were emitted by non-OECD countries, and 2,253 (57 percent) by OECD countries. In 1992, the world emitted 5,968 million metric tons of carbon from the consumption of energy, of which 3,089 (52 percent) were from the non-OECD countries and 2,879 (48 percent) were from the OECD countries. As a group, the non-OECD countries have emitted more carbon from energy consumption than the OECD countries every year beginning in 1982.

Ms. TIERNEY. China now is the second largest emitter of greenhouse gases after the U.S. Their growth rate in burning of fossil fuel is enormous. The developed countries are committed to meeting their own international commitments. Last month the Department of State and the Energy Department were at a meeting of the energy ministers from the developed countries, in which they were laying out how their energy policies will be modified to meet those commitments. Everyone recognized that we will soon be surpassed by the emissions rates of the developing countries, even if we do everything that we can.

I mentioned that this is, not surprisingly, one of the reasons why this Administration is interested in piloting joint implementation strategies as ways to enable private funding as an additional vehicle to public funding to help curb those emissions growth rates in developing countries.

Senator LIEBERMAN. That means having American companies work on pilot programs in the developing countries for the greenhouse emissions.

Ms. TIERNEY. Yes.

Senator LIEBERMAN. This is a development that is so natural and yet it is going to be difficult—and for that reason, difficult to deal with. These are developing countries and they are aspiring to live the good life that we live. Certainly we wouldn't want to discourage them, but it is very hard, particularly to convince them that they should go at it in a different way than we have. And yet it has consequences for the whole global climate change problem. So it is a challenge for leadership and it obviously affects how significant our role is in terms of what we do here at home because this is a global problem. Anyway, I appreciate what you have said.

Senator Faircloth, welcome.

Senator FAIRCLOTH. Thank you, Senator Liebermann. I appreciate your holding this hearing and you certainly have an issue that is wide open for debate. If I heard correctly, Ms. Tierney, you

were saying that the rate of emissions into the air was much greater in the developed countries than in the underdeveloped.

Ms. TIERNEY. I want to be clear that I said the rate of growth in emissions in developing countries is skyrocketing compared to the growth in the developed world.

Senator LIEBERMAN. Although the emissions in the developed countries are greater than the developing countries.

Ms. TIERNEY. Yes.

Senator FAIRCLOTH. In the developing. Are we saying the temperature is getting hotter? In other words, the greenhouse effect——

Ms. TIERNEY. Yes.

Senator FAIRCLOTH. The temperature is increasing?

Ms. TIERNEY. Let me try to be clear about what I mean when I say yes.

Senator FAIRCLOTH. That is what I would like you to be.

Ms. TIERNEY. And I need to put my bona fides on the table. I am not an atmospheric scientist and I am going to tell you the character of the science as the administration scientists understand it. So, with that qualifier, and knowing that you have a panel of scientists about to follow, let me try to answer your question.

Senator FAIRCLOTH. All right. You mean as the Administration understands it, is that what you said?

Ms. TIERNEY. Yes. My only thing is that I am a policy wont, I am not a scientist. So that's a distinction I am making.

Senator FAIRCLOTH. Very courageous admission.

[Laughter.]

Ms. TIERNEY. Here is what scientists agree on, and then I am going to tell you a little bit about what——

Senator FAIRCLOTH. What scientists agree on? I haven't seen anything that scientists agree on. I am reading things that say it is getting colder and we are going to freeze to death in a hundred years.

Ms. TIERNEY. Let me say this very carefully. What the body of the scientific community understands is happening is the following—and then I am going to follow that with what they are pretty sure—the body of scientists in the community believe is happening, and then what they agree they don't know.

Senator FAIRCLOTH. The body of scientists in what community?

Ms. TIERNEY. The International—IPCC—Panel on Climate Change, which is an international panel of scientists examining this question under the sponsorship of countries around the world.

Senator FAIRCLOTH. Primarily the United States.

Ms. TIERNEY. No.

Senator FAIRCLOTH. Go ahead.

Ms. TIERNEY. Okay. There are observed increases, clear increases of emissions into the atmosphere of greenhouse gases. Those will be in the atmosphere for centuries after they are once put into the air, they are long lived in terms of their effect and their staying in the atmosphere. There is a lot of year to year and region to region variability in the climate around the globe. And what one observes with the average global temperature is a slight increase in temperature over the last 100 years.

Senator FAIRCLOTH. How much has it increased over the last 100.

Ms. TIERNEY. 0.3 percent centigrade change in the average global temperature.

Senator FAIRCLOTH. In 100 years?

Ms. TIERNEY. In 100 years.

Senator FAIRCLOTH. What was it the 100 years before that?

Ms. TIERNEY. I don't know.

Senator LIEBERMAN. Senator Faircloth, on our next panel we have some folks, including one from the Congressional Office of Technology Assessment who brought some charts and are going to testify specifically to that.

Senator FAIRCLOTH. Okay, go ahead.

Ms. TIERNEY. The scientists—this same body of scientists—believe that given the increases in concentrations that are being observed, that we know are occurring, that based on what we know about the effect of that and the effect on the globes mean temperature, we would expect to see in the next century increases of from one to five degrees centigrade. Now there are people who would tell you many more and many less than that. But it is strongly held by this body of scientists internationally that we will see maybe a five degrees centigrade increase in this next century, whereas we only saw a small increase in the last.

That level of increase and its effect on the environment, the global environment, is pretty well known. That will lead to sea level rise. In the Chairman's home state of Connecticut, and in my home state of Massachusetts, those many feet of sea level rise will inundate scores of miles. It is well understood, that that would occur.

Senator FAIRCLOTH. I don't think you are right in predicting this great temperature rise. They haven't been able to predict the weather for tomorrow yet, and now they're telling you what it will be like 150 years from now.

Ms. TIERNEY. It is precisely what you are saying—we cannot predict tomorrow, but when one looks over time at the body of data showing changes, there has been observed increase in the global mean temperature, surface temperature. And we know enough about the increase in emissions to predict confidently that there will be continued increases.

Senator FAIRCLOTH. You keep using the words "pretty sure."

Ms. TIERNEY. Let me tell you, the reason I am saying that is that I'm not a scientist. That is why I am saying that.

Senator FAIRCLOTH. I don't think the scientists are sure either. They are less than pretty sure. I read that it is getting hotter, then I read it is getting colder. And the different scientists—depends on whose scientist you listen to—tells you whether we are going to freeze to death or have this melting of the Polar Icecap and all of the potentials that might come from it. I think we have had a series of scare stories. What I am coming at is the history of the country, this Nation, particularly in the last 30 or 40 years, has there been any problem, imaginary or real, potential or without potential, that we have taken one course of action, that we have had one understanding and one rule to follow. I'm not pretty sure about this, I'm absolutely sure. What we do, we throw money at it, vast amounts of money. Somebody creates a problem and then we create

a bureaucracy to look after the problem, so we have to create more problems to make sure the bureaucracy keeps going. That's exactly what we have done over and over and over. Maybe the temperature is rising, but it is rising a lot slower than the Federal debt.

Ms. TIERNEY. Could I comment——

Mr. SUSSMAN. Can I——

Senator FAIRCLOTH. Yes, you can say something.

Mr. SUSSMAN. I'm chafing at the bit here to make a——

Senator FAIRCLOTH. Well, don't break the bit, speak it.

Mr. SUSSMAN. I will do that. First of all, I don't think that we are creating a vast bureaucracy here. I think what we are trying to do is harness the spirit of innovations and technological change in the private sector and——

Senator FAIRCLOTH. How many people are in this agency—clean air and the group that you are with—how many people were in it 15 years ago?

Mr. SUSSMAN. In our agency, I could not tell you.

Senator FAIRCLOTH. How many are in it today?

Mr. SUSSMAN. In our clean air group?

Senator FAIRCLOTH. Yes.

Mr. SUSSMAN. I would venture to say 3,000 or 4,000, but that would be an estimate.

Senator FAIRCLOTH. Then you are creating a bureaucracy, is 3,000 or 4,000 just sort of a get-together group. How many would you think it would take to have created a big bureaucracy?

Mr. SUSSMAN. Excuse me?

Senator FAIRCLOTH. What would that be? You say you haven't created a big bureaucracy, how many would it take to be a big bureaucracy—3,000 or 4,000 is just a kind of little picnic group.

Mr. SUSSMAN. Well, I would like to focus on climate change.

Senator LIEBERMAN. They have much larger picnics in North Carolina than in Connecticut.

[Laughter.]

Mr. SUSSMAN. I am the last person to say we ought to be creating a big bureaucracy, but I do want to make the point that this is a plan which looks to energy efficiency investments by the private sector as the driving force for emissions reductions. And I would submit that even if we weren't concerned about climate change, and we have every reason to be concerned about climate change, but even if we weren't——

Senator FAIRCLOTH. But climate change is up or climate change is down?

Ms. TIERNEY. What?

Senator FAIRCLOTH. You are talking about climate change; the climate has been changing since the dinosaurs were here.

Mr. SUSSMAN. That's right, but the point that I wanted to make is that these investments that we are encouraging the private sector to make are good for productivity, they are good for efficiency, and they are good for the economy. And we think that they are helping our private sector, they are helping——

Senator FAIRCLOTH. You think they are helping the private sector? Does the private sector think they are helping them?

Ms. TIERNEY. Yes.

Mr. SUSSMAN. I think many people in the private sector do think that.

Senator FAIRCLOTH. Many don't.

Ms. TIERNEY. They don't have to join them, the ones that don't. The ones that don't join them will be shooting themselves in the foot, however, because these are programs that will save them money on their energy bills.

Senator FAIRCLOTH. We go back to—and Senator Lieberman—we imagine a problem, we create a bureau. Now maybe there is this problem, maybe there isn't. But once we create a bureaucracy there is going to be a problem because we are going to find one to keep the bureaucracy going. Nothing has grown faster in the last 20 years than EPA, and all of the ramifications that come with clean air. I'm well sensitive to the fact that we've got to protect the environment. I am not insensitive to it—but we've gone with these organizations, we're now around the world, we're getting into undeveloped countries. I heard you say, if I understood right, that we were putting money in to the undeveloped countries to try to encourage them to clean up their air. Is that not right?

Senator LIEBERMAN. Those are private programs, aren't they?

Ms. TIERNEY. Those are private programs.

Senator FAIRCLOTH. No government money going into third world nations?

Ms. TIERNEY. There is some government money. It is not a large amount, and it is——

Senator FAIRCLOTH. How much?

Ms. TIERNEY. Country studies program is $25 million over 2 years.

Senator FAIRCLOTH. Into where?

Ms. TIERNEY. Sixty countries, helping them reduce their greenhouse gas emissions, helping them understand efficiency improvements in their energy sectors. In fact, having them understand what possibilities there might be for advanced technology solutions for which U.S. firms might have an export role to play.

Senator FAIRCLOTH. But this is only part of the different IP funds we are putting into these countries for many, many programs, and funds we don't have, and that's what I am getting at.

Ms. TIERNEY. Let me comment on that. The President's Climate Change Action Plan, in fact, has a deficit reduction component. The net effect of short-term spending on this program increases funds into the Treasury, a greater number of funds into the Treasury.

Senator FAIRCLOTH. Now would you explain that to me.

Ms. TIERNEY. Yes.

Senator FAIRCLOTH. That I would like to hear.

Ms. TIERNEY. I mean the concept is pretty simple. We will spend money on programs to provide technical assistance to remove market barriers, to having companies invest in energy efficiency, for example, company XYZ. They save money, they have greater productivity, they therefore have more taxable revenues.

Senator FAIRCLOTH. In these countries.

Ms. TIERNEY. In the United States. Additionally, there are two programs that literally are net winners in terms of revenues into the Treasury. These will require Congressional approval and there will be legislation filed this summer. One of them is a bill to allow

non-federal investment to upgrade hydroelectric facilities, dams, Federal hydro-dams. And the entity, whether it is a private company or a municipal electric company, or whoever is willing to fund the upgrade, pays revenue through a lease payment to the Federal government, and then sells the electricity that they produce on the private marketplace. It produces funds for the Federal Treasury above and beyond those funds that are paying to support the other programs.

There is a similar one associated with "cashing out" free parking benefits to employees of companies where the company today has leases, at parking facilities, and therefore could avoid leasing the parking facility, if they offer an employee the opportunity to take cash. That cash is taxable income.

Senator FAIRCLOTH. Your kind of growth and economic bureaucratic thinking is the reason that we have a $4.5 trillion debt today and the reason it is going to $6 trillion sometime in 1996, and this continues. The reason that we are building a debt of $800 million a day, we've tacked on several million dollars since we've been talking here, that your children, and your children's children are going to have to pay, ad infinitum.

Senator Lieberman sees it daily. I haven't seen a bad cause since I've been here. Every one has been a wonderful reason to create a new program and to substantiate the ones we've got. Nobody has said stop, everybody has said spend more and we'll do more. Truth of it is we are spending ourselves into some sort of economic chaos and the people that we are trying to protect, that we think we're protecting, are going to be the principal sufferers. I thank you.

Senator LIEBERMAN. Thank you, Senator. Maybe in the next panel the scientists can convince the Senator of what I have concluded respectfully, which is that there is a problem here, that the globe is warming. One of the interesting facts that will come out in the next panel is that this has happened before, climate change has gone up and down over the years, but this is a time when because we are more sophisticated than they were those thousands of years ago, we see it happening and we have the opportunity to try to affect it before it affects us, as I believe it surely will.

Also, I would say, in defense of these folks, that we've been fairly miserly with them, perhaps appropriately so. They are having trouble getting this program going. Maybe we should set up a new standard as to whether we can correlate the increases in the Federal deficit with the increases in global climate change and see if we can try to keep them both down.

Senator FAIRCLOTH. After this winter we would have a significant decrease.

Senator LIEBERMAN. I did ask that question and I was advised not only by this panel, but by my own scientific experts, that that was a temporary and regional change that does not affect the trend, which seems pretty clear. But let's call the second panel where the folks have been looking at this.

I want to thank you. Let's see, I am not going to be as specific as I was in October with the 6 months. I look forward to having you back at the end of the year and see where we are, particularly after the September declarations that were referred to. Thanks very much.

Ms. TIERNEY. Thank you, we welcome that.

Senator LIEBERMAN. See you soon.

Let's call the second panel: Dr. Stephen Leatherman, who is Director of the Laboratory for Coastal Research, University of Maryland, College Park, MD; Mr. Michael Bowes, Senior Analyst of the Office of Technology Assessment; Ms. Margaret Davidson, Executive Director of the South Carolina Sea Grant Program, and Mr. Franklin Nutter, President of the Reinsurance Association of America.

We thank you all for being here. As you've heard in the last round of questioning, there may not be unanimity in Congress on the fact that the globe is warming, so we look forward to your testimony on that question.

We wanted on this panel to focus on one particular element of global climate change and that is rising sea levels.

Dr. Leatherman?

STATEMENT OF STEPHEN LEATHERMAN, DIRECTOR, LABORATORY FOR COASTAL RESEARCH, UNIVERSITY OF MARYLAND

Dr. LEATHERMAN. Yes, Senator.

Senator LIEBERMAN. Thanks for being here and we look forward to your testimony.

Dr. LEATHERMAN. Thank you very much. A significant portion of the United States population presently lives on the coast and the coast is continuing to urbanize at a very rapid rate.

Senator LIEBERMAN. In fact that rate is increasing. I think it is important to say as we consider the impact of global climate change on sea levels, that people are continuing to move toward the coast.

Dr. LEATHERMAN. That is correct, Senator. There is a shore-ward migration of the population towards the coast and it is urbanizing at more than twice the national rate.

Senator LIEBERMAN. The coasts are urbanizing?

Dr. LEATHERMAN. That's correct. The coastal areas are continuing to urbanize in North Carolina, and in other areas. We are seeing a significant growth of the population there. It seems that everyone wants to live or recreate on the coast. It's the top destination area.

At the same time, we are seeking to support those burgeoning populations. Infrastructure is being built on the coast, not only private investment in hotels and houses, but also roads, utility lines, sewers and such that support this development. So what we have now is a developing vulnerability, because at the same time, we are watching sea level rise and the beaches erode.

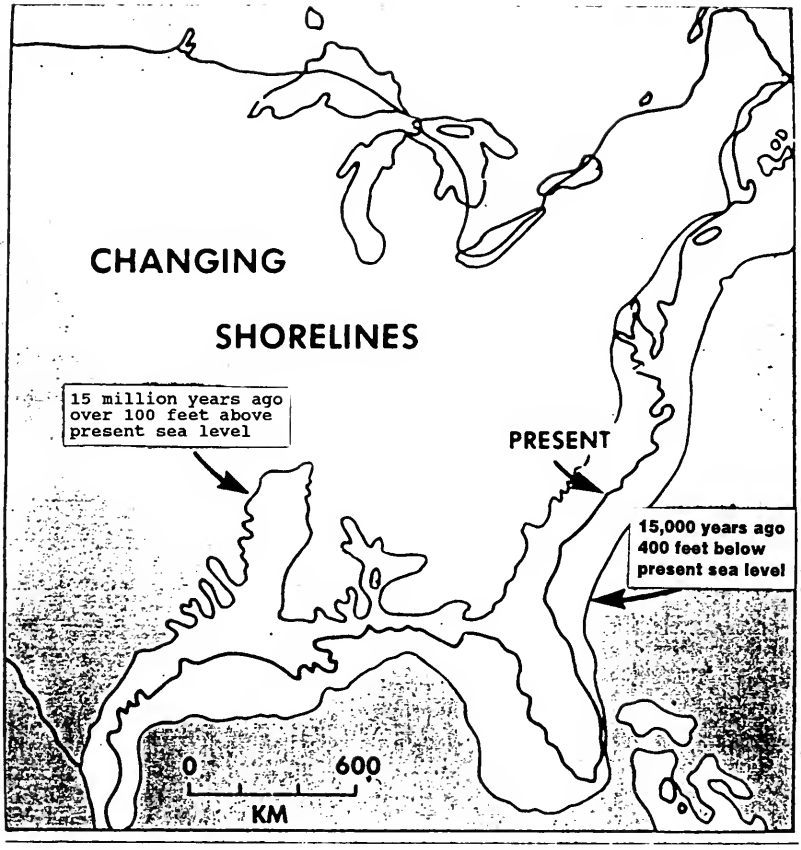
And in fact, if we want to look at the change in sea level over time, we have a few graphics here today.

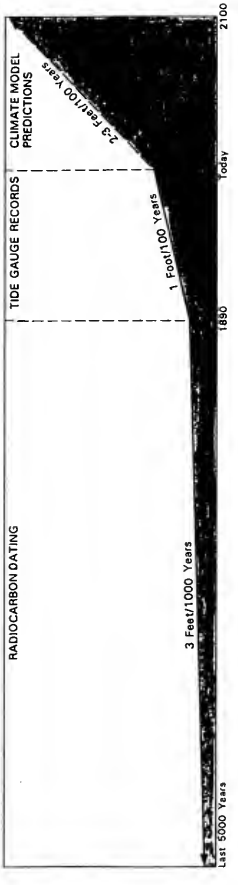
Senator LIEBERMAN. Let's turn that one so Senator Faircloth can see it.

Dr. LEATHERMAN. This will be the first one, Senator. Sea levels and climate have changed throughout geologic time. And if we look at much earlier times, 15,000 years ago when we were in an Ice Age, glaciers came all the way down to Long Island (covered Connecticut, by the way). At that time sea levels were about 400 feet below where they are today, and you would have to go a couple of

hundred miles from the Outer Banks or from Ocean City, MD, even to find the oceanic water. Since that time, the world has been warming up. And as the world has warmed, the ice sheets have melted, retreated northward, and the oceans have filled up.

And interesting enough, there was a period much earlier in time—this was millions of years ago—when sea levels rose so high that the oceanic shoreline came all the way into the Washington, DC area.


CHANGING
SHORELINES
15 million years ago
over 100 feet above
present sea level
PRESENT
15,000 years ago
400 feet below
present sea level
0
600
KM


RADIOCARBON DATING
TIDE GAUGE RECORDS
CLIMATE MODEL PREDICTIONS
3 Feet/1000 Years
1 Foot/100 Years
2.3 Feet/100 Years
Last 5000 Years
1890
Today
2100

Senator LIEBERMAN. Right. So, on this map, which is an overlay of the U.S. obviously, 120,000 years ago you had waters 30 feet above present sea level, so no Florida, no Louisiana.

Dr. LEATHERMAN. Well, Senator, that's actually not the right date. That turns out to be about 10 million years ago, but they didn't get the right numbers on that last night. But yes, we've had higher sea levels during earlier times, but it was about 10 million years ago. And the point I was going to make is——

Senator FAIRCLOTH. You are talking about 100,000 years ago or——

Senator LIEBERMAN. It's 10 million, I gather?

Dr. LEATHERMAN. Yes, it's 10 million. But what I am really saying is that in much earlier times the sea level came up all the way up to where cities like Raleigh, NC, Richmond, VA, Washington, DC, Philadelphia, PA, exist today. They are all built on the edge of the coastal plain where we find the hard rock (the piedmont) beginning. And that marks where the coastal plain ends and the coastal plain marks as far inland as sea levels have been in geologic time.

So at any rate, what I wanted to say is sea level can be thought of as the dipstick of climate change. It is really a balance between the amount of ice on the land and the amount of water in the oceans, and that's the way we look at it today. In the last 100 years, put more into human timeframes, sea level has been clearly rising. We have tide gauges, hundreds of tide gauges around the United States, and indeed around the world. If you look at those tide gauge records, you get——

Senator FAIRCLOTH. Why? If I may just butt in, what's causing it?

Dr. LEATHERMAN. Well, there are two reasons, Senator Faircloth, that has caused the rise. One is that we are seeing a melting of glacial ice, particularly mountain glaciers. Maybe last year you saw the news story about the emergence of the Ice Man. It made quite a bit of news—this guy who fell into the ice 5,000 years ago and appeared at the snout of one of these glaciers. Because valley glaciers are retreating up their mountain pathways, the water locked up in the glacial ice is flowing to the rivers and reaching the oceans.

The other reason for it, Senator, is that the earth is warming up, it has warmed up about one degree fahrenheit in the last hundred years, and as you warm water, it expands. Just like a tea kettle; you take a tea kettle, eventually it will whistle. Now we are not going to warm up the earth that much, obviously, but any time you warm water, the first couple of hundred feet of the ocean water warms up and that, of course, brings the sea level up. And so those two effects are raising sea levels worldwide.

And then we have another effect. The other effect is the fact that the land is subsiding. And this is true in North Carolina, along most of the U.S. East Coast, the land is slowing sinking——

Senator LIEBERMAN. As a result—are we talking about erosion?

Dr. LEATHERMAN. Not exactly, but land subsidence yields erosion. Both these factors eventually yield erosion, but I am explaining why sea level is rising and it is really two factors. There is the

worldwide rise of sea level due to global warming, and there is a second effect of the ground sinking, naturally subsiding.

Senator FAIRCLOTH. So many people on the beach, Senator Lieberman, they are pushing it down into the water.

Senator LIEBERMAN. I see.

Dr. LEATHERMAN. Sheer weight.

[Laughter.]

Senator FAIRCLOTH. Fifteen thousand years ago the ocean was 400 feet farther out?

Dr. LEATHERMAN. No, it was 400 feet lower.

Senator FAIRCLOTH. Than it is today?

Dr. LEATHERMAN. And that made it 100 to 200 miles farther seaward than it is today.

Senator LIEBERMAN. That's a large distance.

Dr. LEATHERMAN. A huge distance.

Senator FAIRCLOTH. Our beach was 400 miles out?

Dr. LEATHERMAN. If you wanted to go to the beach 15,000 years ago, Senator, you would have had to drive 200 miles east of today's shoreline to find the ocean water, 200 miles.

Senator LIEBERMAN. Because 400 feet translates into that distance.

Dr. LEATHERMAN. That's right.

Senator LIEBERMAN. In other words, you could have a couple of feet rise in a place like Connecticut, but it would cover a good distance.

Dr. LEATHERMAN. Well, there are counties in North Carolina, that are sitting right at sea level. There is a place called Sea Level, North Carolina, and these areas, if you raise sea level a foot, the shore is going to move in about a mile.

Senator FAIRCLOTH. All right, when was the ocean further inland than it is now?

Dr. LEATHERMAN. Well, it has been inland many times in the past.

Senator FAIRCLOTH. In other words, where I live you dig up oyster shells which is clearly evidence of oceans——

Dr. LEATHERMAN. That's correct, Senator.

Senator FAIRCLOTH. When was that?

Dr. LEATHERMAN. Well, where do you live?

Senator FAIRCLOTH. Clinton, 60 miles inland from Wilmington.

Dr. LEATHERMAN. Okay, well those oyster shells, I would probably think are something like a few hundred thousand years old.

Senator FAIRCLOTH. All right, why did it recede? Why did the ocean—according to your theory, and I'm sure it is right, if I wanted to go to the beach how many years ago, I would have had to drive 200 miles east of Hatteras.

Dr. LEATHERMAN. Well, that would be 15,000 years ago.

Senator FAIRCLOTH. All right, how many years ago could I have stepped out my back door and been in the ocean?

Dr. LEATHERMAN. Two hundred thousand years ago.

Senator FAIRCLOTH. All right, why was it up then?

Dr. LEATHERMAN. It was much higher than because it was an inter-glacial period of time.

Senator FAIRCLOTH. You said it was hotter then?

Dr. LEATHERMAN. It was warmer. The earth gets warmer and it gets colder. That's right, Senator. The earth changes its climate. It oscillates on these cycles.

Senator LIEBERMAN. Let me just ask this question because it is related. I think your line of questioning is important to get through it. One of the things we are naturally going to ask as we hear about rising sea levels at earlier times, is what caused it, because now we are operating on the assumption that global climate change is caused by more developed human activities, burning of fossil fuels, manmade activities which were way beyond what was happening on the earth in that period of time. And so, why did the earth warm at that time?

Dr. LEATHERMAN. Well, the earth is spinning on the axis, and if you look at something called the Milankovitch Theory, what it shows is that a slight change in the earth's tilt over thousands of years frequency changes the amount of the sun's radiation reaching the earth, and that sets the onset of glacial and inter-glacial periods. We know for a fact that glaciers have advanced and retreated four times in the last 2 million years. This is natural climatic variability, there is nothing we are doing about that. But what is interesting is that if we look at what controls the climate of the earth, it's these greenhouse gases. If you look at what is in the air, it is about 78 percent nitrogen, and 21 percent oxygen. Neither one of those gases, which adds up to about 99 percent of the earth's atmosphere, has anything to do with the global temperature. It turns out that less than one percent of the gases in the atmosphere, the so-called greenhouse gases, control our temperature.

Senator LIEBERMAN. So would you say——

Dr. LEATHERMAN. And these greenhouse gases—excuse me, Senator—are carbon dioxide, water vapor, methane gas, nitrous oxide. Then, of course, we have introduced some new ones chemically called CFCs. Now what's interesting is that here you've got a very small part of the atmosphere, one percent, that's controlling our climate. Now we know this to be true because if you look at Venus, Venus has ten times or more carbon dioxide concentration than we have on earth, and it has temperatures of 600 or 700 degrees fahrenheit. You can melt medal on the surface of Venus. Obviously we can never land a spaceship there, it is too hot. It is what people call the runaway greenhouse effect on Venus.

You look at Mars, it has almost no atmosphere. It's too cold, it's always freezing on the surface of Mars. So the greenhouse effect is a reality, it is not a theory. It's like the story of the three bears, not too hot, not too cold, just right. The earth is just right. But the problem is that during the Industrial Revolution, greenhouse gases have increased by 25 percent. Remember they are only a small fraction of what is in the atmosphere, but they control our climate.

Senator LIEBERMAN. Okay, and this is unnatural.

Dr. LEATHERMAN. And that's unnatural.

Senator LIEBERMAN. In other words, it is different from the natural greenhouse gas increase that created some of that increase in sea level earlier because of the tilting of the earth.

Dr. LEATHERMAN. That is correct. And so that's what worries all the scientists is the rate of change in many ways, more than the absolute change. The rate of change is so rapid that climate change

in the next hundred years which would take thousands of years for nature really to do it. We could adapt to a very slow climate change; animals can and we can slowly adapt. But when the rate of change is so rapid when it is compressed down ten times or a hundred times what it would be in a natural cycle, how can ecosystems adapt? We are seeing the salt marshes fall apart in the Chesapeake Bay. We are seeing the marshes in the Outer Banks of North Carolina on the mainland eroding 10 to 20 feet a year. Coastal erosion isn't a secret, anywhere you look in the country.

Senator LIEBERMAN. And again the important point that strikes me is that as we are seeing this, we are all moving toward the coast. So in a way, assuming what you are saying is correct, which I accept, we are sort of walking into the problem.

Dr. LEATHERMAN. We look at it as sort of a collision course. We are all rushing toward the shore and the shore is rushing toward us.

Senator LIEBERMAN. Right. I presume back millions of years ago what animals and whatever human life species were around did was to go inland. But it's going to be harder for us to do that.

Dr. LEATHERMAN. During the times of the Native Americans, they just picked up their camps and moved because we have been losing land over time. But the rate has accelerated in the last hundred years. In fact, we have a graphic showing how slowly sea levels rose for thousands of years. We know this from radiocarbon dating of material. Then the tide gauge record clearly show that in the last hundred years sea levels have come up one foot. And then, of course, the climate model predictions are for much more rapid acceleration.

So over these time frames you can see there has been acceleration in the rate of sea level rise. Fairly stable beaches in earlier times are now starting to erode. Areas that were eroding slowly are now starting to erode faster, and the prediction is for beaches to erode faster in the future. We can counter this erosion with beach nourishment, bulkheads, jetties and sea walls, but they are expensive. And as the erosion continues, how much can we afford, getting back to your question about the national debt.

In the last 10 years the U.S. Army Corps of Engineers has spent about $8 billion just pumping sand, pumping sand grains from point a to point b, pumping sand off the ocean bottom to put it on beaches.

Senator FAIRCLOTH. Pumping it from point a to point b, and the oceans and the waters are moving it back from point b to point a——

Dr. LEATHERMAN. Precisely.

Senator FAIRCLOTH. —faster than they are pumping it.

Dr. LEATHERMAN. In some places, that's——

Senator FAIRCLOTH. We were talking about the beach. Now we have a four wheel drive vehicle and a 30-foot boat behind it.

That's the way we go to the beach, and we used to go on Saturday morning, sometimes Friday afternoon, now it's Thursday.

Senator LIEBERMAN. Thursday and not only that, we're living there. That's the fascinating thing, we see this rising sea level and yet we are all drawn to the water. So we are building more houses, more businesses, and you know if all this is right, it is therefore

going to be much more difficult to deal with the rising sea level because we are going to be planted so firmly. I know one of the things we are going to hear about, including North Carolina, is some of the programs that are beginning to be put in place at the State level to try to prepare for this.

Do you want to describe the islands, Dr. Leatherman.

Dr. LEATHERMAN. Yes. Well, I was going to save that part, but sea-level rise has caused significant coastal land loss.

Senator FAIRCLOTH. May I ask a question.

Senator LIEBERMAN. Go ahead.

Senator FAIRCLOTH. Is there any scientist, Dr. Leatherman, that disagrees with the theory of the warming climate?

Dr. LEATHERMAN. No scientist I know of disagrees with the precepts of the greenhouse effect controlling the climate of this earth. In other words, if it weren't for the greenhouse effect, then we wouldn't be living here today. We wouldn't have the average temperature of 60 degrees Fahrenheit that we have on the earth today. So without these gases, these greenhouse gases of carbon dioxide and methane, water vapor, and the others I mentioned, we wouldn't be able to live here. So no one disagrees with that, Senator.

What's in question, and I see these same articles, they come across my desk, is the fact that we cannot yet prove scientifically that the buildup of carbon dioxide in the atmosphere is responsible for the observed global warming we have seen in the last century, which has been about one degree fahrenheit.

Now, at the same time, we can't really prove scientifically that cigarettes cause smoking. From the chemistry, we can't nail down those hundreds of chemical agents. Statistically, we could see a good correlation. And by the way, I grew up in Charlotte, NC, and my family is in that state now, so I know the story of the tobacco industry. But the point of it is, science is very pure, and we have to have absolute cause and effect, bottom line proof, otherwise we can't say it. But I can say this, there is a worldwide consensus that the buildup of greenhouse gases is going to cause global warming in the coming decades.

Senator LIEBERMAN. And there is a worldwide consensus that global warming is occurring?

Dr. LEATHERMAN. Oh, yes.

Senator LIEBERMAN. That is, the planet is getting warmer and that the sea level is rising.

Dr. LEATHERMAN. Yes, we have temperature measurements on that. If you look at the hard data sets showing that sea levels rising. There is no question about that. There's no question that the earth has warmed up because we have temperature gauges which have been operating faithfully for over a hundred years.

Senator FAIRCLOTH. Going back thousands of years, we've obviously had enormous warming of the temperature rise because the water was up to St. Louis.

Dr. LEATHERMAN. That's correct.

Senator FAIRCLOTH. The water was into Raleigh, NC, 120 miles from the ocean.

Dr. LEATHERMAN. Also, I should mention, Senator, there are some other factors—the tectonic deformation of the earth, that op-

erate over 100s of millions of years. The earth is not stable itself. The ocean floor is spreading. Every year we are about an inch farther away from Europe.

Senator FAIRCLOTH. But at one point it was 120 miles inland.

Dr. LEATHERMAN. That's right.

Senator FAIRCLOTH. What caused that?

Dr. LEATHERMAN. Well, as I was saying, there are two reasons for that. There's the worldwide change in climate, and there is the change——

Senator FAIRCLOTH. What caused that worldwide change in climate? There were no automobiles then.

Dr. LEATHERMAN. No, that's right. The earth goes through major climatic changes regardless of whether there are any people here or not.

Senator FAIRCLOTH. In terms of the lengths of time you are talking about here—we are talking about a very short term climatic change.

Dr. LEATHERMAN. That's right. What we think we are doing to the atmosphere now is very short term because in terms of this glacial, interglacial periods, warming, cooling, those are 100,000 year periods.

Senator FAIRCLOTH. The thing we are talking about and spending a load of money on, and to use a bad analogy, but aren't we trying to beat the ocean back with a boat paddle? And that we aren't having much effect and aren't going to have much effect. And that the natural tendencies of the world—warm, cool, are going to go on as they have for millions of years regardless of what we do?

Dr. LEATHERMAN. This will happen. In fact, right now we are living in what's called the climatic optimum. We are at the top of what normally should be the highest temperature. And you've read articles about we're heading toward an ice age. Yes, we're heading toward an ice age if we didn't have greenhouse effect, but it would take 15,000 years to get there. You've got to think in terms of time frames. I am always dealing with people on the coastline who say "I built a beachfront house here, now how can I expect that it will erode away when I built it 100 feet from the water?" Well, you go down to Cape Hatteras, you've got an erosion rate of 15 feet a year, it doesn't take many years to get you.

The reason I wanted to show this graphic is because the shorelines have moved hundreds of miles through time. Why is it a surprise to somebody that the beach would erode 100 feet in their lifetime? But to answer your question, Senator, it's time frames. The time frame is what is so important in this greenhouse effect, because we are looking at what we are doing over the periods of the next couple of decades to the next century to our climate and how it can influence us in terms of rapid rising sea level and rapid coastal erosion and land loss.

Senator FAIRCLOTH. Thirty years ago, I was with the North Carolina Highway Department. At that time a good friend of Senator Lieberman's was Governor and I was running the Highway Commission.

[Laughter.]

Senator LIEBERMAN. A good partnership.

Senator FAIRCLOTH. We wanted to build a bridge—very controversial—at Oregon Inlet.

Dr. LEATHERMAN. Bruce Bonner Bridge.

Senator FAIRCLOTH. Herbert Bonner.

Dr. LEATHERMAN. Herbert Bonner, excuse me.

Senator FAIRCLOTH. It was a great bargain. We were going to get $1 million of free money from the Federal Government, across the most unstable body of water maybe in the world, Oregon Inlet.

Dr. LEATHERMAN. A very dangerous inlet.

Senator FAIRCLOTH. I voted against it and worked against it. They swept me out of the way on the theory that all good people do good things. This was going to be for the children that were—they had some 18 children down there that they needed to get off the Outer Banks. So we were going to build this $3 million bridge. I said, and was highly ridiculed for it, but I said it anyway, that it would be cheaper to take these children and their parents and put them in the Pierre Hotel and keep them there in perpetuity than it would be to build a bridge and a road. But we built the bridge. Now the bridge is 20 years old, it is already washing away. I don't want to belabor the point, but to show you how ridiculous some of the things that we are doing.

Dr. LEATHERMAN. I agree with you.

Senator FAIRCLOTH. They had the bridge practically built and then came something called "The March Storm." It completely filled up under the bridge——

Dr. LEATHERMAN. In 1962.

Senator FAIRCLOTH. —and there was a path cut by a new inlet. Well we spent more money pumping out under the bridge and getting the inlet filled up than we did building the bridge.

Dr. LEATHERMAN. Well, Senator, I can remember——

Senator FAIRCLOTH. Then we built a road on the Outer Banks.

Dr. LEATHERMAN. Highway number 12.

Senator FAIRCLOTH. —wonderful thing, paved road. But we were afraid the ocean was going to bother the road, so we planted sea oats to stabilize and refertilize it. They grew, the dune grew, the road sunk. But we built up the road, but to keep it from washing away, we planted more sea oats and more dunes and the road was down. So we got us about a 5 foot road. This is a story of fooling with the Outer Banks. The seagulls decided that the finest place in the world to crack a clam was to drop it on the highway, so they would fly, drop it, it would crack, they would dive and get the clam out. We are now spending a half a million dollars a year sweeping the clam shells off of the highway——

[Laughter.]

Senator FAIRCLOTH. —so you can drive on it. But in the meantime, we decided that the way to do it, rather than sweep, was to build some pads for seagulls to drop their clams on.

Dr. LEATHERMAN. Did they know that, Senator?

Senator FAIRCLOTH. We did that.

Senator LIEBERMAN. Dr. Leatherman wanted to know if there was communication with the seagulls before that was done?

Dr. LEATHERMAN. Right.

Senator LIEBERMAN. To see that they would cooperate with the——

Senator FAIRCLOTH. They did cooperate. We had to keep their pad clean or they wouldn't use it.

Dr. LEATHERMAN. Fascinating.

Senator LIEBERMAN. Let me ask this favor, if I may.

Senator FAIRCLOTH. That is totally aside and a boring analogy, but we've seen this same bureaucracy over——

Dr. LEATHERMAN. Well, Senator, one of the things that might interest you, Charles Frazier is the one who developed Hilton Head Island, and he was once here in Washington at a hearing like this and he said he was always surprised that the Outer Banks were ever developed.

Senator FAIRCLOTH. What?

Dr. LEATHERMAN. Charles Frazier, the developer of South Seas, Hilton Head Island, SC, he's the one that developed that.

Senator FAIRCLOTH. The south point?

Dr. LEATHERMAN. The south end of it, that's right. And he said he was always surprised that the Outer Banks were developed. He says look at this land, just a ribbon of sand and yet—he says I never thought they would develop that, I was very surprised that someone actually came out there and put the road in, the bridges, everything else, to make that happen. But I suppose we ought to get back to——

Senator LIEBERMAN. Let me ask this favor. One of the witnesses has to leave at noon, and I've been joining you in our interruptions of Dr. Leatherman, which have been good ones. Let's see if we can let him finish and then go on through the panel and let Mr. Nutter get on his way.

I shouldn't engage this too much longer, but one of my reactions to that story, which is a marvelous story, is that part of what we are talking about, in a way, is don't fool with mother nature. In other words, nature is going to work its will. And part of what we want to talk about here is how do we adapt, we're leaving aside for a moment your point which is are manmade carbon dioxide emissions—the direct cause of global warming. We do see scientifically that the planet is warming, that the sea level is rising.

Dr. LEATHERMAN. Yes.

Senator LIEBERMAN. Part of what we want to talk about here is how do we adapt to that.

Dr. LEATHERMAN. If you look at this one graphic, this is a small island, Poplar Island in the Chesapeake Bay, and you can see through time going back to 1848 to 1987, the amount of land loss. And this is true for many islands. This island was depopulated, they had to abandon the island in 1929 because it was no longer tenable to live there. And the reason for it was not only the erosion, but the island is very low and the salt water moved inland as the sea level came up, and killed all the fruit trees and made it impossible to grow any crops. And also, the water wells went saline. The people couldn't live there anymore. This is the story of many islands. In fact, Michener, in his book called Chesapeake, talks mythically about one of these islands doing the same thing.

On a larger scale, we are seeing that 70 to 90 percent of the sandy beaches in the United States are presently eroding at rates from less than a foot per year up to about 50 feet per year in the state of Louisiana. And this is not a trivial problem. Also, at the

same time, we are seeing a loss of very valuable wetlands, salt marshes. In the Chesapeake Bay, where we have been working, an area called Blackwater National Wildlife Refuge, part of the Atlantic coast flyway for geese and ducks, we have lost a third of that acreage in the last 50 years. Five thousand acres has basically drowned and submerged as sea level has come up, and the reason for it is that these marshes are in delicate balance with existing sea levels. And again, it's the rate problem. These marshes have been there for 5,000 years, and yet in the last 50 to 100 years, the rate of sea level rise has been too rapid and essentially they have been waterlogged, drowned, and now disappearing. This is happening in many other areas. It is happening at the rate of four acres an hour in Louisiana.

So if you put all of this together, we already have a problem. We have a problem along the coast, as we said earlier——

Senator FAIRCLOTH. I have a quick question. If you could wave a magic wand today, and that would put our pollution back to where it was at the turn of the century, how much would that affect the rise in the ocean or do you think it would stop? What effect, what percentage of this rise in the ocean that we are seeing, if you could just sweep the automobile out and the industrial age, pretty much, the major industrial, from the turn of the century, swing it back 94 years, how much, what percent do you think you would change the rising of the sea level?

Dr. LEATHERMAN. I think the story is in the graphic right there, Senator. You see what has happened since 1890 and how steep it is going up. Look at the time before, it was flattened out more, that lower curve of sea level rise.

Senator FAIRCLOTH. It's gone up one foot in a hundred years.

Dr. LEATHERMAN. Yes, but it's only gone up three feet in the last thousand years.

Senator FAIRCLOTH. That's not my question. You missed my question. I know it's gone up.

Dr. LEATHERMAN. I guess what I am saying——

Senator FAIRCLOTH. If there had been no so-called greenhouse effect by emissions, what would this be?

Dr. LEATHERMAN. We feel that the curve——

Senator FAIRCLOTH. Would there have been none?

Dr. LEATHERMAN. No, it would have gone up.

Senator FAIRCLOTH. What's the percentage?

Dr. LEATHERMAN. It would have been about 50 percent less than what we see in the last 100 years.

Senator FAIRCLOTH. What would have made the 50?

Dr. LEATHERMAN. The 50 percent would be the land subsiding. That's not a global factor.

Senator FAIRCLOTH. We would have had no increase in the sea level——

Dr. LEATHERMAN. No, we would have had an increase, about a half a foot.

Senator LIEBERMAN. I take it that what you are saying is that the first part, which says three feet over a thousand years, basically that line would have continued at the same rate.

Dr. LEATHERMAN. Exactly, Senator Lieberman. That is what I am trying to say.

Senator LIEBERMAN. If there was no——

Dr. LEATHERMAN. No global warming—that's exactly right. We would expect to see no accelerated sea level rise due to greenhouse gases. We would expect to see that historical trend of the slowly rising sea level, not the accelerated rate we see in the last 100 years, that's correct.

Senator FAIRCLOTH. This warming trend has got to be highly speculative.

Dr. LEATHERMAN. The date 1890s, Senator, is speculative in the sense that that's our earliest good tide gauge record. Now clearly the accelerated sea-level rise could have started 10 years before or 20 years before. We are not quite sure of the exact date.

Senator FAIRCLOTH. That's what I am trying to say, did this rise start back out here?

Dr. LEATHERMAN. Well it couldn't have started too much earlier or we would be much higher on the curve than where we are today, Senator. If it started 500 years ago, sea level would have been much higher. We would have already seen 5 feet of sea level rise rather than one foot.

Senator FAIRCLOTH. What percentage of it is attributable to pollution within the air. You are bringing this at a same rate, actually we did not really start to bring this greenhouse effect or the air pollution until somewhere along in here.

Dr. LEATHERMAN. Well, the Industrial Revolution began in 1870.

Senator FAIRCLOTH. I am well aware of when the Industrial Revolution began. But what we are saying now is the greenhouse effect is caused by carbon dioxide. And a principal source of it is automobiles.

Dr. LEATHERMAN. And burning of any fossil fuels.

Senator FAIRCLOTH. But principally automobiles, isn't that right?

Dr. LEATHERMAN. I guess today it is automobiles.

Senator FAIRCLOTH. They are the big contributors.

Dr. LEATHERMAN. That's correct.

Senator FAIRCLOTH. All right, but as we know it today, we didn't have automobiles until 1950. A few people had automobiles, but I don't know how many of you are old enough to remember, but it was after World War II that the automobile became as necessary as a nose for people to exist.

Senator LIEBERMAN. I presume the burning of coal in factories at the beginning of the Industrial Revolution had something——

Dr. LEATHERMAN. That's correct, Senator Lieberman. In fact, in Philadelphia in the late 1800s, there was so much coal burned individually by people that there was incredibly bad air pollution. You couldn't even see the sky on a clear day, they say, in downtown Philadelphia. That how much coal was being burned individually by people trying to keep warm.

Senator FAIRCLOTH. Well, the same thing was true at Fort Jackson, I mean if you were in the Army. But before that we were burning wood and wood is, I understand, a——

Dr. LEATHERMAN. It produces carbon dioxide too.

Senator FAIRCLOTH. What?

Dr. LEATHERMAN. Wood, when you burn it, produces carbon dioxide.

Senator FAIRCLOTH. Well, what are we going to stay warm with?

Dr. LEATHERMAN. Well, that's the point. We are a carbon-based society and the point of it is try to make it more efficient, the way we are burning this fuel. Plus we've got a rising population, which is a great worry to me, frankly.

Senator LIEBERMAN. Why don't you go back and see if you can finish your testimony. Then we'll go to Mr. Nutter.

Dr. LEATHERMAN. Okay. I think I am about finished. All I was going to say is that we're seeing beach erosion as a nationwide problem. Coastal wetlands are disappearing in response to a too rapid rate of sea level rise. Basically the coast is on a collision zone. Another thing is that we can anticipate more hurricanes, more large class four and five hurricanes, like a Hurricane Andrew, which ended up costing $30 billion to the insurance industry.

Senator LIEBERMAN. Why? Why is that related to the trends you are describing?

Dr. LEATHERMAN. Well, there is a correlation—if you look at it—when we have very warm oceanic water, warm summers. Hurricanes get started in the South Atlantic and when that water is much warmer, there tends to be larger hurricanes formed during that year. And that is the relationship that has been worked out by meteorologists. Now there is some debate about that particular aspect, because some people say that when you warm up the air and the water, you don't have the differential temperature. But there's pretty good evidence that we will see more severe, some people say even more frequent, hurricanes. And the other thing to consider is that hurricanes only form in a band of very warm water, and as the earth warms up, as the surface waters warm up, that band of warm water where hurricanes can form is going to be closer to the United States and be a wider band. And so that in itself is quite worrisome and gives us the prospect of more intense hurricanes in the future.

So I guess my final line is unfortunately that we can expect more coastal disasters in the future and larger insurance payouts, both by the Federal Government through the flood insurance program, and by the private insurers. Thank you very much.

Senator LIEBERMAN. Thank you, Dr. Leatherman.

Mr. Nutter, am I right that you have to leave by noon?

Mr. NUTTER. I would like to if that's possible. If not, I'll stay.

Senator LIEBERMAN. Okay. Well why don't you go ahead, if it is all right with the two of you. Why don't you go ahead and maybe we'll even get you out early.

STATEMENT OF FRANKLIN NUTTER, PRESIDENT, REINSURANCE ASSOCIATION OF AMERICA

Mr. NUTTER. I will merely summarize my statement. It does contain a number of charts and lists of data related to the point that was just made about the relationship between natural catastrophes occurring in the United States and losses, people and property, in the United States.

I represent the Reinsurance Association, which is an association of property casualty reinsurance companies. My intent is to reflect upon the experience the industry has had broadly with natural catastrophes and the losses that people have experienced in this country.

Looking at data supplied by Swiss Reinsurance, it is quite evident that the number of natural catastrophes occurring world wide has risen rather dramatically in recent years. They estimate that even in the 10 year period of the 1980s that the number of natural catastrophes has increased nearly 94 percent. Interestingly enough, the number of natural catastrophes in the United States has not changed dramatically in the last 20 years, averaging somewhere between 30 and 50 natural catastrophes, but that there is a fairly dramatic increase in the number of such natural catastrophes over prior periods.

What is most notable about these statistics is not the number of natural catastrophes, but the magnitude, and particularly the insured value and insured losses as a result of them. Prior to mid-1988, worldwide, the insurance industry had not experienced losses from a single catastrophe event of greater than $1 billion. Since mid-1988, the insurance industry worldwide has experienced 14 such events. That peaked in 1992 in this country, primarily as a result of Hurricane Andrew, with total catastrophe losses of nearly $23 billion. Of the 20 largest insured catastrophes affecting the United States, 15 of those have occurred since 1989. Twelve of those involved a combination of wind, notably hurricane, and water, notably flood or wave wash affecting coastal development.

There are clear trends which have been referenced both in the research that has been presented to the committee, and in earlier testimony, that in addition to climate and weather affect insurance loss experience. Certainly this includes population shifts to the coast. Without restating the statistics in my statement, it is notable that our population is moving to very high risk areas and the natural consequence of that is greater insured exposures along coastal areas. Our estimate are that in coastal communities, which basically are those communities from Texas through the Gulf Coast and up through the East Coast, is that the amount of insured property value is about $2 trillion. It's a fairly large number, even inside the beltway. What's most notable is that it has increased since 1980 from $1.13 trillion, a dramatic increase in insured values in our coastal areas.

Our industry's ability to assess the potential loss from these natural catastrophes has improved in recent years, primarily because of computer modeling of losses. One of my exhibits reflects our estimates of potential losses from realistic storms that could occur in various parts of the United States. In all cases in the example cited, the potential insured losses range from $25 billion in insured loss from a force four hurricane hitting New Orleans, to something in the neighborhood of $52 billion in insured losses, not counting loss of life, from a class four hurricane that would make land fall in New Jersey and go up the coast through Connecticut and other coastal states.

A particularly important point was made at the end of the last testimony, that the insurance industry does have insured exposure to floods, which, of course, has been a prominent issue discussed here today. But much of the residential flood exposure comes under the National Flood Insurance Program where the Federal Government is at risk. Perhaps the best statistic is to indicate that in the midwest flooding of 1993, the estimated damage was $10.5 billion

in losses. Of that, $745 million, certainly less than a tenth of that, was insured in the private insurance industry. Much of the rest of that was either insured in the National Flood Insurance Program or was financed by disaster assistance and recovery from the Federal Government.

If we look, at past disaster, past natural events that have actually occurred in the United States, and updated those to 1992 dollars and 1992 insurance markets, meaning how many properties are in those areas now versus the past 40 or 45 years, we see almost staggering numbers associated with the potential loss of property and life in high risk areas.

Our industry has reacted to what has been a notable trend in the last few years by undertaking three initiatives. One is the creation of the Insurance Institute for Property Loss Reduction which intends to focus on building codes in coastal communities and the enforcement of building codes. The industry hopes to use its economic clout and insurance premiums to improve what communities are doing to resist damage through better building techniques. In addition, this institute will study and research building techniques, design and materials to try and improve what the construction industry is doing in the way of home construction in high risk coastal areas.

Secondly, quite frankly, a lot of insurance companies are reevaluating their insured exposure in these high risk areas. They have raised rates, they have raised deductibles, they have looked at the quality of coverage in terms of additional living expense, and done other things to do two things; one is protect themselves against financial ruin as a result of natural catastrophes, but two, to try to help insureds deal with the rising cost of insurance in these areas. That has created tension between the insurers, between policy holders and regulatory officials.

And the third major initiative is that the industry is very supportive of a bill now pending before the Senate, the Natural Disaster Protection Act, which is S. 1350, sponsored by Senator Inouye and 16 others bipartisan co- sponsors, which does in fact address the question of hazard mitigation and natural disasters.

In conclusion, Senator, I would say that the insurance industry stands second in line behind the actual victims of natural catastrophes in being affected by these catastrophes. You can partially explain the industry's fairly dramatic experience in recent years by the population shift and the insured value increase in coastal areas. But my conclusion is that you cannot explain it all by that and that our industry can and should do more to understand the causes of changes in our climate, to assess, as this Committee is seeking to assess, whether or not there are manmade causes that should be addressed by public policy initiatives. We commend the committee for taking this dramatic step. Thank you.

Senator LIEBERMAN. Thank you, Mr. Nutter. I think that's very powerful testimony and it does make the point that the odds are pretty high that we are paying—this is one of the problems—it may cost us to take action, but we are also paying a lot for inaction. Would you, coming off of these numbers, think that we should be urging people or we should be taking actions that are designed

to stem what seems to be a natural movement of people toward the coasts?

Mr. NUTTER. That's a good question, Senator. I think our industry probably accepts the fact that at least the current attitude of our country is that people are free to live where they want to live. The development of barrier islands and coastal communities is something that State and local officials perhaps even encourage by using federal dollars and federal policy. Having heard Senator Faircloth's suggestion about the bridge is a good example of that.

Our industry feels very strongly about taking action to protect property and life by trying to mitigate the effect of these natural catastrophes. We have not taken the step of endorsing restrictions, zoning and other restrictions, on development. But it certainly is one policy option that ought to be considered, both here as well as the State and local level.

Senator LIEBERMAN. You've indicated in your testimony the dramatic increase in insured loss over the last 50 years. If you looked forward 50 years from now, and assuming some of the same trends continue that we see continuing here, what is most likely to happen in terms of the insurance industry? Is the industry likely to pull out of insuring along the coast line or are premiums going to go up astronomically or——

Mr. NUTTER. Or both. I think what you've described is happening now. I don't think you have to wait 50 years. Certainly in Florida and South Carolina and Louisiana, and a number of other east coast States, we already see insurers reevaluating. And by that I mean placing practical operating policies in place to try and reduce, if possible, or at least hold static, their exposure to risks they write in this area. You also have insurance agents, the public, and regulatory officials seeking to hold those companies in those States, not withstanding the risk. So you have that tug and pull between potential threats to the solvency of insurers, with the commitment on the part of the industry to maintain insurance. The industry is in business to sell insurance, not to deny insurance. Rates have gone up because they reflect the losses that are being experienced. It's as simple as that, it's the nature of the business.

I don't think you have to wait 50 years. I don't know what it will be in 50 years, but I would suggest that a series of policies, certainly a long-term point of view looking at climate and weather, is very consistent with the more immediate policy of trying to find ways to provide a safety net under our industry, mitigate against damages, and put in place policies with respect to development that are going to be responsible in light of what seems to be an inevitable change in climate, both gradual and sudden.

Senator LIEBERMAN. Thanks, Mr. Nutter. I appreciate your patience and you are free to depart whenever you want.

Mr. NUTTER. Thank you very much.

Senator LIEBERMAN. Mr. Bowes and Ms. Davidson, thank you, too, for your patience.

Let's go to you now, Mr. Bowes.

STATEMENT OF MICHAEL BOWES, SENIOR ANALYST, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. BOWES. Mr. Chairman, thank you for the opportunity to share with you some of the findings of OTA's recent assessment preparing for climate change. My name is Michael Bowes, I am an economist and senior analyst at OTA, and one of the authors of this assessment. I will be summarizing briefly some of the main conclusions of this report and Margaret Davidson, one of our study advisory panel members, has kindly agreed to present more specifically the conclusions of the coastal chapter.

This is the second OTA report on climate change. In 1991 we published "Changing By Degrees" which focused on ways to slow emissions of greenhouse gases. Concerns about climate change have since then led more than 160 countries, including the United States, to sign a treaty agreeing to take steps toward stabilizing emissions of the greenhouse gases.

We feel that despite such international efforts, a bulk of the evidence suggests that simply stabilizing emissions at present levels will not be sufficient to stop global warming. Unless the predictions of climate models are seriously flawed, average temperatures worldwide can be expected to increase. If indeed some climate change is inevitable, then so is the need to adapt. Society and nature may have to cope with rising seas, more frequent droughts and heat waves, changes in water supplies, threats to the health of our forests, and perhaps to the stability of our agriculture systems.

Senator LIEBERMAN. Mr. Bowes, could you, very briefly for the record—there was an interesting exchange between Senator Faircloth and some of the witnesses—on what OTA concludes about the scientific evidence regarding the effect of human activity on the increase in global warming and, therefore, the increase in sea level that we all seem to agree is occurring.

Mr. BOWES. Yes. The previous OTA assessment concluded that it would require controls on the order of 60 to 80 percent below current levels of emissions in order for us to stabilize the climate.

Senator LIEBERMAN. So, OTA has concluded therefore that human activity, which is unnatural in the sense that it is not caused by the natural forces at work in the world over the centuries, is in fact causing the global warming that we are seeing?

Mr. BOWES. I think we have to be cautious in saying it has caused the increase we have seen. There is no doubt that increases on this level could cause the changes we have seen. And I would add that we would be back around the turn of the century levels of emissions if we achieved 60 to 80 percent cuts in current levels.

Senator LIEBERMAN. Right, and the "could" is strong enough that it leads you to support the kinds of reductions that we are talking about in greenhouse gas emissions?

Mr. BOWES. Excuse me, I am not sure I got the question.

Senator LIEBERMAN. What I am saying—you said that human activity could cause global warming, but I presume that because you are commenting on—in other words, there is enough of a concern that you have that it is causing global warning that you think we ought to take the steps that we are taking to reduce the emissions of these gases.

Mr. BOWES. I am a cautious person but I believe there is enough evidence here that we should be prepared to take steps. I will acknowledge that this raises some difficult issues as to how we address this control of CO_2.

Senator LIEBERMAN. Okay, go right ahead.

Mr. BOWES. Sea level rise itself could lead to higher storm surges and increased erosions of our coasts. Perhaps of equal concern, the loss of coastal wetlands may be accelerated and with that we would find many of our fisheries threatened. Unfortunately, although understanding of climate change has progressed, major uncertainties do remain. Some of the key information that might guide specific policy on management responses to the potential impact of climate change is likely to remain unknown for some decades. Given our inability to predict it accurately where, when, or how much climate change will occur, any decisions we do make about how to respond to the threat of climate change will have to be made in the light of considerable uncertainty.

OTA was asked by Congress how we might cope with these uncertainties. Specifically OTA was asked: "Given the uncertainty about future climate change, are there any useful actions that can be taken now?" Our assessment examined six natural resource systems; the coastal zone, water resources, agriculture, forest, wetlands and preserves. We looked at the ability of these six systems to adapt to climate change and to consider means by which their adaptation could be enhanced.

OTA concludes that despite the underlying uncertainty, the Nation can indeed position itself to better cope with a wide range of possible climate futures. Not only are there options that could be implemented now, delay in responding may in some cases leave our Nation poorly prepared to deal with those changes that do occur.

We find two general approaches that seem likely to be most helpful. First, we suggest improving society's ability to adapt to any change. Second, we suggest improving the general health of our national resource systems. Congress can enhance society's ability to adapt through actions that we fit broadly into three categories. One, improve the technology, the information, and the know-how required for private adaptation. Two, improve the planning and preparedness for current climate extremes, by which I mean such things as droughts and floods. And finally, remove the institutional impediments that limit the incentive to respond to climate risk. I think this category is of particular importance in the coastal zone where various subsidized programs, including the National Flood Insurance Program, encourage development in high risk zones, development that we may find is a costly liability if sea levels indeed rise. Already over 40 percent of the flood insurance claims are for properties that have been damaged more than once, half of these in the coastal zone. We suggest that Congress consider revising the National Flood Insurance to reduce the potential liabilities that result from this build-destroy-rebuild cycle.

Another major target of opportunity is the upcoming reauthorization of the farm programs in the 1990 Farm Bill. This reauthorization provides an opportunity for considering how climate change may affect federal expenditures on the disaster assistance programs and commodity support programs. And we should consider

whether these programs themselves are unnecessarily limiting the farmer's flexibility in responding to climate risks.

OTA also has suggestions as to how to address the health of our natural resources. Again, we put these in three categories. First, and I suspect most importantly, we suggest reducing the ongoing threats to our natural resources, and we are particularly concerned about the fragmentation and loss of wetlands and natural areas. Second, we suggest the need for contingency plans to deal with some of the more severe potential consequences of climate change. And we suggest such things as a forest genetics bank. We are not particularly good at dealing with forest species in the same manner that we have dealt with agricultural species. We need some insurance that might protect us against threats of severe loss of species. Third, we support research in maintaining or restoring declining ecosystems that have been threatened by climate changes. It is this last category that may be particularly important. So far the Nation has spent some $1.8 billion a year on its climate change research program. This has not addressed the natural resource management or the ecological science questions that might give us some practical guidelines for adaptation to climate change. We suggest that Congress ensure that the U.S. GCRP, Global Change Research Program, in fact be broadened to make natural resource and ecosystems research a key component.

In the report itself we identify some 100 specific options. We have categorized many of these as first steps that we think are particularly important to address now. Within the written testimony there are summaries of our conclusions with respect to each resource and the first steps for each sector are summarized. Thank you.

Senator LIEBERMAN. Thank you, Mr. Bowes, and thanks for those constructive suggestions.

Ms. Davidson, again, thanks for your patience. We look forward to hearing your testimony.

STATEMENT OF MARGARET A. DAVIDSON, EXECUTIVE DIRECTOR, SOUTH CAROLINA SEA GRANT PROGRAM, CHARLESTON, SC

Ms. DAVIDSON. I am Margaret A. Davidson, I'm Director of the South Carolina Sea Grant Program and as Mr. Bowes mentioned, I was on the advisory panel for the OTA report Preparing For An Uncertain Climate. I would like to quickly reiterate a few comments that my colleagues have made and then move on to some key points.

Civilizations always began at the water's edge for a lot of logical reasons—food, waste and transportation. And it is certainly clear that in the last century, and indeed in our country in the last 30 years, that we have surged to the coast. In fact, about half of the nation's population lives in that area that we generally define as the coast, which is only 10 percent of our property. That means that the sheer number of people and capital investment at risk is dramatic. And the irony of this, of course, is that while we want the freedom to live in high hazard places, we would like to have the government subsidize our movement into those areas, and then

when the inevitable risk does occur, we would appreciate the government insuring us against that risk.

There used to be this legal principle called "assumption of the risk" and I generally believe that as a matter of policy in this country, we should move back to this. We will never be able to get people to move away from high hazard areas to a great degree, but perhaps if we let them cover their own risk, they might be a little more discreet in their decisions.

When Mr. Nutter spoke about the exposure of the insurance industry, he mentioned that his figures did not cover the off-budget charges to the Federal government, such as the Flood Insurance Program and other disaster relief efforts. The other thing I would like to emphasize is that in the last 5 years of major storms, Hugo, Aniki and Andrew, that as dramatic and as costly as they were, none of them hit a major population center. We have indeed been fortunate as these hurricanes have resumed. I suspect that our good luck will not hold for long.

But what I want to talk about specifically is that part of our country which is considered most at risk from climate change and natural as well as increasing rates of sea level rise; the coast is where everybody lives. We have a number of regulatory programs which have attempted to redress this movement to the coast with more sound development practices. Certainly the Coastal Zone Management Act which was passed about 20 years ago was the first comprehensive effort to do so.

Coastal wetlands are, however, less well protected than coastal beach faces, simply because they are an amalgam of federal programs and executive orders that attempt to address wetlands; we don't have a comprehensive national approach to wetlands, as you well know. Coastal wetlands, like coastal beaches, are at great risk. In fact, the greatest efforts that are being taken today are by State and local governments, largely through the coastal management programs, which as you know, are state oriented programs, but also through some other state and local efforts.

Within the framework of the coastal zone program, which is a voluntary program, State and Federal governments participating to enact better guidelines for coastal development, there are about 13 States which have set back requirements. That is, you should get back from the beach a certain distance which is generally related to the trend line in erosions that Dr. Leatherman referred to. North Carolina actually has been one of the premiere states in that effort. Typical development projects have to be set back 30 times the annual erosion rates. And if we are talking large scale development projects, major hotels, that sort of thing, they need to be set back at 60 times the annual rate.

Now one of the reasons in my opinion that North Carolina has been a leader in this is because there are not that many people yet who live on the North Carolina coast. States like Florida which have enacted set back ordinances as well have had to deal with it because in a place like Florida you are certainly aware of the impact of coastal storms when your whole state could be classified as coastline. In South Carolina, we enacted a set back line based on long term erosion trends, and we certainly found out after Hurricane Hugo that the political will to enforce those set back require-

ments during reconstruction was highly variable, particularly since the governor's house was located within an area that had been substantially damaged. We modified our set back ordinances a little bit in 1990.

Senator LIEBERMAN. So the Governor moved his back or——

Ms. DAVIDSON. No, under the newly perceived approach to redevelopment, he was able to rebuild his house.

Senator LIEBERMAN. A high hazard Governor.

Ms. DAVIDSON. Well a fiscally conservative Governor.

Senator LIEBERMAN. I see.

Ms. DAVIDSON. The States of North Carolina, South Carolina and Maine are among the leaders in those states which have prohibited what we call hardening of the shoreline, bulk heads and other sorts of things which attempt to hold back the sea. Like I tell the Rotary Clubs, "The Lord giveth and the Lord taketh away," and no where is that more true than on barrier islands. I think that more states need to look very carefully at this policy of preventing a hardening of the shore line because while hardening does not hold back the sea, it usually displaces the erosion problem to the nearest downdrift area that doesn't have a hardened shoreline.

Since the 1990 amendments to the Coastal Zone Management Act, there are 17 States that are explicitly looking at the issue of sea level rise and how it affects their regulatory and guidance programs. Part of that was mandated by the amendments in the 1990. A number of States require real estate disclosures; instead of teeny-weeny little print, a larger type print at the bottom of the contract that says "this property is located in an area that may be subject to erosion." I think that's good and gets us more toward assumption of the risk, provided that people read those long contracts, which, as you well know, they don't.

A number of states have enacted building codes specifically for coastal areas. Florida, and again, North Carolina, lead in that. The requirements, technological things that you can do to ensure that your roof doesn't blow away, are really fairly minimal costs, probably a couple of hundred dollars to keep the roof on a house during 150 mile hour storm. The problem is enforcement. We found after Hurricane Andrew that there was, shall we say, uneven enforcement of building code requirements and perhaps not full understanding by the construction industry as to how these things work. Even in my own State of South Carolina, we are beginning to look at this issue of specific building codes for these high hazard areas.

To protect coastal wetlands, States like Maine and Maryland have enacted wetland buffers. In order for coastal wetlands to deal with increasing sea level rise, they need to migrate inland. If the shore is hard, they cannot migrate. If we reduce the sediment supply through our penchant for dams and reservoirs, there is no new material to build coastal wetlands. And remember that wetlands are, in fact, the thing which buffers us against coastal storms, even when we don't have barrier islands to protect us.

What will we do about these areas—in places like New London and the Barrier Islands of North Carolina and South Carolina and throughout the east coast and the gulf? There are a number of federal programs and federal opportunities that could be immediately addressed over the next couple of years. Mr. Bowes referred to the

National Flood Insurance Program. You have an opportunity right now to affect the shaping of that program. Let us ensure that FEMA does consider sea level rise in developing its maps and setting its premium rates. This is an important thing to do. I think we also should tie federal disaster assistance to states' hazard mitigation plans and the actual implementation of those hazard mitigation plans.

I would also suggest that Congress might want to consider the threshold at which we trigger disaster assistance and maybe even the threshold at which we have presidential declarations of disaster. The number and frequency of presidential declarations is increasing and at lower and lower levels of damage. In the last couple of major disasters, the Federal government opted to pay a hundred percent of costs instead of requiring State and local share. Congress could also reduce the subsidy embodied in the Tax Code for casualty loss deductions; enable people to bear the true cost of their decisions to live in these areas. The Coastal Zone Management Act is up for reauthorization in 1995. Let us strengthen provisions that pertain to states developing hazards management plans and building controls.

As for the Army Corps of Engineers, which is a subject of some interest to this Committee, we have subsidized a lot of hardening of shorelines and a lot of moving of sand from point A to point B. The benefits of these programs are largely state and local. Why don't we shift these program costs to those areas which derive the greatest economic benefit and encourage the Army Corps of Engineers to get out of the shoreline hardening business and the beach renourishment business. At a minimum, if that is politically unfeasible, then let's reduce the level of Federal government contribution from our current approach of providing funds up to 75 percent in some cases for beach renourishment, and let's change these costs to revolving loan funds, much as EPA now does with the construction of treatment facilities.

The Clean Water Act is up for reauthorization. Let's have integrated watershed management and not only define wetlands, but attempt to maintain a no wetland loss. My colleague referred to the reauthorization of the Farm Bill next year, our opportunity to further protect wetlands.

And last but not finally, I would like to mention the importance of public education. Certainly the private insurance industry sees an increased need for public education about these issues, these risks, and what we as individuals can do about it.

Let's work with the private sector to do broad based public education. A number of universities are engaged in these kinds of efforts. I would like to note that Yale started recently a degree program just this past year on integrated watershed management with a major component dealing with natural disasters in coastal watershed areas. I think that should be encouraged.

And if I may, a diminutive ad here, programs like the National Sea Grant Program, which work with universities and with State and local governments to understand the impact of these issues and how we can change them at the local level play a major role.

In South Carolina, when Hurricane Hugo came, we had supported wind research, but we also had a PC based software disk

ready to go that would enable engineers and builders to do a better job of rebuilding to reduce their hazards for wind. We helped develop the state hazards mitigation plan and, in addition, we are now working with the insurance industry in South Carolina to see if we can't address their concerns and their losses at the same time trying to provide some margin of coverage for folks who have already committed their lives and their monies to these high hazard areas.

Thank you, Senator.

Senator LIEBERMAN. Thank you, Ms. Davidson. Very good testimony. I appreciate the three of you being here, but I regret that because of the hour that I not going to be able to—and maybe you don't want to be asked questions. What we will do is submit them to you in writing if that's alright, and appreciate your response to them. You've been excellent, both in documenting the problem and in withstanding a rather intense interrogation. Dr. Leatherman, I thought you held up very well, but made the point, and undoubtedly your background in North Carolina was a major assist in taking that stand. And I appreciate the testimony of the two of you, and particularly the suggestions.

This Subcommittee considers this to be a very important problem, a real problem, a longer range problem for which—again, the political difficulties here—we are trying to take action that will affect people further on down the road, and therefore, as a mother would undoubtedly say this may be one in which we will receive our true rewards in the next life because we will not be around to experience all the benefits. Although when you listen to the dollars and hear some of the other consequences that you described, we are already in the midst of this problem and it already is costing us.

Anyway, I thank you very much. You have been excellent witnesses. The record will remain open for three weeks and the hearing is now adjourned.

[Whereupon, at 12:15 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

PREPARED STATEMENT OF ROBERT SUSSMAN, DEPUTY ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY

Thank you for the opportunity to discuss the Environmental Protection Agency's (EPA's) implementation of the Climate Change Action Plan. When President Clinton released the plan, he stated it is "the most aggressive and the most specific first step that any nation on this planet has taken in the face of perhaps the biggest environmental threat to the planet." The President committed his Administration to periodically evaluate the emission trends and program effectiveness, and to pursue additional policy initiatives if the trends indicate that our progress is insufficient to attain our goal. Since the President announced the plan, EPA has focused on establishing programs to reduce greenhouse gas emissions as quickly and efficiently as possible. An integral part of this effort has been the establishment of simple, clear indicators of progress for plan implementation.

EPA and the Department of Energy (DOE) co-lead an interagency effort to track progress of the Climate Change Action Plan. We have established a framework to evaluate progress towards the national goals. The framework consists of three major activities. First, EPA works with the Department of Energy's Energy Information Agency (EIA) and the Department of Agriculture to develop and update inventories of emissions of greenhouse gases. The national inventory is the ultimate signal of progress towards meeting the President's commitment to reducing emissions to 1990 levels by the year 2000. But the national inventory is too general to rely upon for detailed evaluation and fine tuning of Action Plan activities. Therefore, the second

part of the framework are the goals EPA has established for each element of the plan for which we are responsible, and the related indicators of progress set to gauge the extent to which the initiatives are on track. Program indicators and milestones will help to assure the most cost-effective use of resources possible. Third, EPA is working with the Department of Energy to update and evaluate the relationship between the micro-level effects of individual actions and the macro-level effects demonstrated in trends in the national emissions inventory. This evaluation will allow us to better determine the overall performance of the plan, to target improvements in program activities to obtain the most cost-effective emissions reductions, and to guide development of later plans.

ON THE MACRO-SCALE: EMISSIONS INVENTORIES

The ultimate assessment of success of the Climate Change Action Plan will be whether the national inventory of greenhouse gases shows that emissions reach 1990 levels by 2000. Under two memoranda of understanding (MOU) between EPA and the Department of Energy, EPA will continue to work with EIA, the U.S.Department of Agriculture (USDA) and other agencies to maintain and prepare the greenhouse gas inventories (with full interagency review) needed for reporting to the Framework Convention on Climate Change (FCCC). Only the national inventory will include all sources and gases in a comprehensive manner on a national scale. The national inventory will also avoid double counting and will conform to the guidelines of the Framework Convention. The inventory will be cross-checked with the sometime more detailed and precise data available from other sources, such as EPA's carbon dioxide emission monitoring data. The MOU between EPA and EIA lays the foundation for related sharing of expertise, emission factors, methods and data.

The first U.S. inventory was reported internationally in 1991, and the next will accompany the September 1994 U.S. national communication to the FCCC Conference of the Parties. The national inventory will be disaggregated by sector, fuel and greenhouse gas. Because of a lag in the availability of underlying economic and physical data, the national inventory for a given year (for example, 1996) will be available in preliminary form in the next year (for example, 1997) and in final form the following year (for example, 1998).

ON THE MICRO-SCALE: PROGRAM INDICATORS AND MILESTONES

The White House asked EPA to co-lead with DOE the monitoring and evaluation of Action Plan performance across agencies. By December 1993, EPA established specific program indicators and milestones in a standard format to track our progress in implementing the Action Plan and in reducing emissions of greenhouse gases. I am submitting for the record a summary of the current indicators and milestones. This summary reflects our current best estimates of the accomplishments we intend to achieve. EPA will gather information on each indicator on a regular basis—for some programs as frequently as quarterly. We hope to standardize the reporting system across agencies and use this system to report periodically to the Congress, the Administration and the public on what we achieve with the resources spent. Our report will show the extent to which each action has been implemented, the next steps, plans for program improvement, and an evaluation of the overall success to date of the actions. We expect to periodically revise our procedures and indicators as we learn through experience how to better evaluate and run programs.

The Administration will periodically evaluate and report on progress under the plan and will update the plan, if necessary. The Administration will also begin to identify additional opportunities for post-2000 emission reductions. The Administration has also committed to an interagency workgroup to examine policies that could impact greenhouse gas emission levels beyond the year 2000.

In developing the indicators and milestones, we have made an effort to choose measures which are quantifiable, and to the extent possible, linked in a clear manner to emissions reductions. We have worked with the appropriate agencies and departments to ensure that, to the extent feasible, our activities and measures are coordinated with theirs.

Many of the programs will appear to start slowly because they are just beginning. As the programs gain momentum, the rate of emissions reductions will accelerate. We are already beginning to see emission reductions not just of carbon dioxide, but also of conventional air pollutants regulated under the Clean Air Act.

Here is a sample of the measures and milestones we track on a regular basis: each quarter, EPA's flagship voluntary program Green Lights reports the number of new participants, the square footage of buildings recruited into the program, the square footage surveyed and upgraded, as well as an estimate of the number of

pounds of carbon dioxide emissions prevented per year as a result of the implemented upgrades. By May 1994, we expect to have recruited more than 175 partners in our Energy Star Region. By September 1994, we expect to have recruited 150 hospitals and 140 universities, colleges and schools. We expect at least 2,000 total Green Lights program participants by December 1994.

Since the President announced the Climate Change Action Plan in October 1993, the number of Green Lights program participants has increased by nearly 200 to more than 1,300, with an expected total of more than 4 million square feet of space slated for upgrades in lighting efficiency. We are already seeing measurable results in terms of emissions reductions from these early actions. The more than 2,000 upgrade projects already completed prevent emission of an estimated .35 million metric tons per year of carbon dioxide, 5 million pounds of sulfur dioxide and 2.5 million pounds of NO_x. An additional 6,000 upgrade projects are already in the pipeline, and the pollution prevention will accelerate as new partners take action. Green Lights participants have reduced their electricity use by an average of 46 percent and saved a total of $40.5 million per year on their electric bills. However, our efforts must be accelerated even beyond the current pace to achieve our overall goals.

EPA's Energy Star Buildings program is operated in coordination with the Department of Energy's Rebuild America program. So far we have enrolled 10 Showcase partners, and expect to enroll a total of 20 corporate Showcase partners by this June, when we plan to formally kick off the program with a signing ceremony. We expect to enroll 25 full Energy Star Buildings partners by September 1995, and to unveil the related Ally program in January 1996.

The Energy Star Computer program is on track to have the majority of personal computers produced for sale in the U.S. qualify for and display the Energy Star logo by 1995. Resources permitting, we will launch an Energy Star Transformer program and an Energy Star Copier program by Fall 1994.

Programs to reduce emissions of methane and other greenhouse gases are well under way. Over the next 3 years, we expect that 75 percent of transmission and distribution pipelines and 50 percent of natural gas production will be active participants in the Natural Gas Star program. We are on schedule to begin outreach to five states to assist landfills in recovering methane in a profitable manner. This month, we will launch key state outreach programs to encourage profitable emissions reduction from gassy coal mines. In cooperation with the U.S. Department of Agriculture and the Department of Energy, we have expanded our marketing and implementation support to swine producers under the AgStar Program.

The initiative to accelerate source reduction, pollution prevention and recycling expects to present its detailed 5-year plan, enroll 15 communities in the Keep America Beautiful "Buy Recycled" program and enroll at least 140 companies in Waste Wi$e by September 1994. Our original milestone for FY 1994 had been 50 partners, but more than 100 companies have already enrolled in Waste Wi$e, so we have set our target higher. The Climate Wise initiative held a public workshop on program design options in December 1993 for industry, trade associations, and environmental leaders. Fifty companies have expressed an interest in the program, and two have joined as premiere signatories. The U.S. Initiative on Joint Implementation is led by the Department of State, but EPA will co-lead the operational portions with DOE. Draft ground rules were published in the Federal Register in January 1994, and the revision will be issued shortly, following public comment and interagency review. The joint implementation initiative will accept proposals this summer with plans to announce the first round projects by the end of the year.

ASSESSING THE RESULTS OF THE CLIMATE CHANGE ACTION PLAN IN REDUCING EMISSIONS OF GREENHOUSE GASES

The question of whether the Climate Change Action Plan will be adequate to meet our year 2000 target will require all three elements of the framework I described earlier. First, the national greenhouse gas inventory will tell us in any given year where we stand relative to our "benchmark" expectations for progress in reducing emissions to 1990 levels by 2000. Second, monitoring and evaluating the performance of the individual initiatives in the plan will tell us the extent to which we believe those initiatives are reducing or sequestering greenhouse gases.But the baseline to which reductions are compared will inevitably shift as economic growth, energy prices and other factors fluctuate.

Consequently, the third step to assess progress towards the national goal is to revise projections of greenhouse gas emissions, and revise our expectations for what the Action Plan will achieve, based on their actual performance and changes in factors beyond the control of the Administration, such as economic growth and appropriations for program implementation. EPA and the Department of Energy will co-

lead an inter-agency process to accomplish this third step. We will revise projections of program achievements, assess the amounts by which we expect the Action Plan initiative to reduce the projected emissions and evaluate how close we are to the target for 2000. The Administration is committed to making this assessment periodically. If further action is warranted, the Administration is prepared to make necessary modifications to the plan.

ROLE OF STATES AND LOCALITIES

State and local governments will make important contributions to the achievement of objectives established by the Climate Change Action Plan. State and local governments are key partners in several initiatives, including Green Lights, Energy Star Buildings, Waste Wi$e, Climate Wise, and Mobility Partners, as well as in several DOE and USDA initiatives. For example, Nebraska, Maryland, California, and Douglas County, Oregon have become full partners in the Green Lights program. They have committed to retrofitting their lighting to achieve the maximum profitable energy savings within 5 years, with rates of return 6 points better than the prime lending rate. In the Energy Star Buildings program, EPA will work with DOE to use the State energy offices to reach the commercial building sector. States may also play an important role in implementation of the Landfill Outreach action, since full participation of landfills will help States achieve compliance with Clean Air Act regulations.

EPA established a State and Local Outreach Program in 1989, which serves as a foundation program to support the Action Plan. The State and Local Outreach Program will coordinate and promote partnerships with States and localities for all the initiatives in the plan, and will provide a focal point in the Federal Government for States and localities to get their questions answered. The program will provide technical and limited financial assistance, including a component to reach out to disadvantaged communities.

Under the State and Local Outreach Program, eight states have prepared greenhouse gas inventories, and seven are working on state climate strategies. Thirteen States are assessing climate impacts such as sea level rise on coastal development or are demonstrating innovative mitigation projects such as telecommuting. Nearly 20 cities are involved in municipal greenhouse gas projects such as Urban Carbon Dioxide Reduction, Cool Communities, and Green Fleets. This year we hope to establish assistance agreements with at least 20 more States and localities. An evaluation component will assess project results and disseminate the success stories and innovations to a national and international network.

In November 1993, EPA issued new rules requiring State and local transportation planners to consider the air quality effects of new highway projects. These requirements, called conformity determinations, will assure that transportation and air pollution control officials at the State and local levels will work together to design transportation systems that conform to air quality goals, including reducing carbon emissions. Before the publication of the conformity rule, EPA and the Department of Transportation met frequently with regional, State, and local transportation officials to discuss the implications of the rule for the transportation planning process. Since the publication of the rule, several workshops have been held to explain the rule. EPA and DOT continue to provide assistance to transportation planners at all levels.

NEED FOR ADDITIONAL LEGISLATION

In general, no new legislation is necessary to assure implementation of EPA's portion of the Climate Change Action Plan. We are assisting the Department of Treasury on one action that needs legislative action. The Parking Cash-Out is an incentive for employers to offer new benefit options for commuters—cash and transit passes to replace subsidized parking. The option requires changes in the tax code. This incentive will relieve traffic congestion and reduce greenhouse gas emissions and urban air pollution, while providing sizable economic benefits through greater tax fairness, efficiency, and flexibility. EPA is working with the Treasury Department and the Departments of Transportation and Energy to develop a formal legislative proposal. However, it will be necessary for Congress to fund the Action Plan.

CONCLUSION

The Administration takes seriously its commitment to the world to reduce greenhouse gas emissions as established in the Framework Convention on Climate Change. We have taken the lead not just to declare policy, but to implement effective programs to meet this goal. We believe that the Climate Change Action Plan is sound, and our commitment is expressed in our policies, in, our efforts to imple-

ment effective programs and in the more mundane but critical work of developing emissions inventories, program indicators, and milestones that will allow us to track and improve progress.

Some concern has been expressed that recent economic and energy market conditions would make it more difficult to reach the 1990 target level by the year 2000 under the plan as currently structured. While this plan was predicated on assumptions about the future and about the impact of programs, it was also designed to be responsive and adaptable to changing circumstances. Specifically, we committed to periodic assessment, review, and, if necessary, expansion. However, the timetable for such review reflects the need to discern short run fluctuations from changes in longer term trends, and we are currently assessing the implications of recent shifts in market conditions on our forecasted levels of emissions. At the same time, we are committing our resources and energy to implementing the ambitious slate of programs currently identified. We continue to have confidence that our programs will deliver the emission reductions that we estimated in October of 1993. Finally, we realize that future economic and energy market conditions may require additional actions in order to return greenhouse gas emissions to 1990 levels by the year 2000. The magnitude of any potential shortfall, however, has not been analyzed, and therefore the kinds of actions that may be required to fulfill the commitment, have not been identified.

We welcome feedback from the Congress on how we might better design and evaluate our programs—as well as your support for full funding of the package—and the encouragement of businesses and other partners to help us make this plan a reality. Funding of the Climate Change Action Plan is essential if we are to reduce U.S. greenhouse gas emissions to 1990 levels by 2000. We need Congressional support for our FY 1995 budget request of approximately $107 million and 153 FTE.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 8 1994

OFFICE OF CONGRESSIONAL
AND LEGISLATIVE AFFAIRS

The Honorable Joseph I. Lieberman
Chairman
Subcommittee on Clean Air and Nuclear Regulation
Committee on Environment and Public Works
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

Enclosed for insertion into the hearing record are EPA's responses to follow-up questions from the April 14, 1994 hearing before the Subcommittee on Clean Air and Nuclear Regulation on the Administration's Climate Change Action Plan. I hope this information will be useful to you and members of the Subcommittee.

If you or your staff have any questions regarding this information, please contact David Gardiner, Assistant Administrator for Policy, Planning, and Evaluation at (202) 260-4332, or Mary Nichols, Assistant Administrator for Air and Radiation at (202) 260-7400.

Sincerely,

Christopher P. Hoff

Christopher P. Hoff
Deputy Director
Legislative Analysis Division

Enclosure

QUESTIONS FROM SENATOR LIEBERMAN

APPROPRIATIONS

Q: **It is my understanding that EPA and DOE have both been denied requests to reprogram a certain amount of funds for 1994 to the implementation of the Plan. How will this affect implementation? Do the denial of these funds indicate a disagreement on the part of the Committee leadership with the agencies' approaches?**

A: The resource reductions will have an impact on the long-term emission reductions that are achieved by EPA's programs to implement the Climate Change Action Plan. At this point, it is difficult to estimate the extent of the impact. Reduced funding in the initial stages of program implementation is likely to slow the start up of the new programs and hinder the acceleration of the flagship programs.

However, we have already begun to implement nearly all aspects of the plan, and have made substantial progress towards this year's goals. For example, since the President announced the Climate Change Action Plan in October 1993, the number of Green Lights program participants has increased by nearly 200 to more than 1300, with an expected total of more than four billion square feet of space slated for upgrades in lighting efficiency. The more than 2,000 completed upgrade projects already prevent an estimated nearly 700 million pounds per year of carbon dioxide emissions, 5 million pounds of sulfur dioxide and 2.5 million pounds of nitrogen oxides. An additional 6000 upgrade projects are already in the pipeline, and the pollution prevention will accelarate as new partners take action. Green Lights participants have reduced their use of electricity by an average of 46% and saved a total of $40.5 million per year in their electric bills. Partners have accelerated their implementation of energy efficiency measures during this period.

Q: **Are there ways for industry to contribute to some of these voluntary programs to help ease some of the funding problems. For example, could some of the industries that have successfully completed EPA's Green Lights program help to provide technical assistance to other companies?**

A: Many of the organizations that have successfully completed EPA's Green Lights program are helping to provide technical assistance to other Green Lights participants. The Green Lights program actively encourages participant interaction and information sharing. This support has included telephone advice, sharing of key documents, site visits, references on contractors, etc. This informal networking is valuable because the "champion" Green Lights partner is viewed as having "real world" experience in implementing Green Lights, with many lessons and insights to share.

In early 1994, the Green Lights program initiated a forum called Partner User Groups (PUGs) to: 1) provide an opportunity for Partners to interact with each other to share ideas and experiences, and 2) enhance participant performance at a modest cost/effort to the EPA. Each PUG is a workgroup that meets on an on-going basis, usually quarterly, to transfer lessons about energy efficiency and Green Lights implementation. Each PUG is chaired by a "champion" Partner and includes several other Partners by invitation. The "champion" Partner helps guide the other participants, answer technical questions, assist with brainstorming, etc. EPA's role is limited to organizing and facilitating the meetings. The Partners themselves conduct and participate in the substantive discussions on Green Lights implementation.

Q: **What percent of the financial responsibility for implementing the Plan is assigned to each of the implementing agencies?**

A: The FY 1995 allocation by agency is as follows:

Agency	FY 1995	% Share
EPA	$107,000,000	33%
DOE	$208,000,000	63%
USDA	$ 12,000,000	4%
Others (BuREC, Corps, DOT HUD)	$ 1,000,000	0%
TOTAL	$328,000,000	100%

PARKING LEGISLATION

Q: **One of the most innovative provisions in the Plan calls for legislation to amend the Tax Code to require employers who pay for employee parking to offer also the choice of an equivalent cash payment for a tax-free transit pass. What is the Administration's plan for enacting this legislation. If no legislation is passed, how would the emission reductions be made up?**

A: Implementation of Parking Cash Out requires changes in section 132(f) of the Internal Revenue Code. For the past several months, EPA has been working as part of an Administration team to develop implementing legislation. This team is led by the Treasury Department's Office of Tax Policy. The Treasury Department is also working with relevant Congressional Committees on this issue. One of the side benefits of Parking Cash Out is that the program will raise small but significant revenues. This is because Cash Out gives people the

choice of taking cash as opposed to a take-it-or-leave-it offer of a tax-exempt fringe benefit. This revenue-positive aspect of Cash Out is, we believe, a key factor in gaining interest for Cash Out in the Congress. As such, we believe that the prospects for timely passage of implementing legislation are very good.

CONGESTION MITIGATION AND AIR QUALITY FUNDS

Q: **The Plan calls for a review of the expenditure of funds from the congestion mitigation and air quality fund provided for in the ISTEA legislation in 1991. At the last hearing in October, I discussed with you my serious concern that these funds were not being spent to promote important Clean Air programs, including the employee commute option program. The leadership of the Committee wrote to Administrator Browner and Secretary Pena on this issue in November urging them to take a leadership role in rectifying this situation.**

Where do you stand in this review?

A: The United States Department of Transportation is currently beginning a process to review the congestion mitigation and air quality (CMAQ) program. EPA is an active partner in this review process designed to determine whether the CMAQ program is meeting its goals and to identify how the CMAQ program's benefits can be maximized. A minimum of ten states will be visited by DOT and EPA representatives to conduct interviews with federal, State and Metropolitan Planning Organization (MPO) officials and other interested parties. The States to be visited that have an employee commute option (ECO) requirement are: California, Illinois, Maryland, New Jersey, New York, Pennsylvania and Texas.

At a recent national meeting of State ECO administrators, an EPA official and a consultant to DOT encouraged the participants to apply for CMAQ funds to assist employers in meeting their ECO requirements. Participants were also urged to comment at the public hearing, to be held on June 2 in Washington D.C. as part of the CMAQ review process, to express concern that CMAQ funding should be used to support services that will make it easier for employers to meet ECO requirements.

FUEL ECONOMY

Q: **The Plan calls for a process to be completed by October to develop measures to significantly reduce greenhouse gas emissions from cars and light trucks including measures to improve fuel efficiency by 2 percent per year over a 10-15 year period. EPA is a co-chair of this process.**

What progress has been made in this effort? What is EPA's role in the Task Force? How does it relate to the Clean Car initiative?

A: The Office of Environmental Policy, the Office of Science and Technology Policy, and the National Economic Council are co-chairing a process to develop policies to significantly reduce greenhouse gas emissions from personal motor vehicles in the years after 2000. On April 14, 1994 the Executive Office of the President published a notice in the Federal Register announcing the Clinton Administration's intent to form a policy dialogue advisory committee under the Federal Advisory Committee Act (FACA). This FACA Committee will include a broad range of stakeholders and will develop recommendations on sets of policies that would, if adopted, most cost-effectively obtain a return to 1990 levels of greenhouse gas emissions from personal motor vehicles by the years 2005, 2015, 2025, with no upturn thereafter. Decisions on the amount and timing of reductions in greenhouse gas emissions from personal motor vehicles, and the policies to attain them, remain the responsibility of the federal government.

The FACA Committee is charged with making its recommendations within one year from its first meeting, which will take place in the near future. The Administration is committed to significantly reducing emissions of greenhouse gases from personal motor vehicles. The Administration will put forward a set of policies and begin implementation of those policies at the end of the FACA committee's year-long period of consideration.

EPA, along with the Department of Transportation and the Department of Energy, are members of the steering committee for the this process, informally known as "Car Talk." EPA staff are also participating in an interagency analytic workgroup, chaired by the Council of Economic Advisors, that will support the FACA Committee's work.

Car Talk and the Clean Car program are two separate initiatives within the Administration. Clean Car is for the purpose of cooperative research and technology development. Car Talk is a policy development process which will examine all methods of reducing greenhouse gas emissions. Technologies that might emerge from the Clean Car R&D effort will certainly be considered as possible mechanisms for reducing greenhouse gases.

Q: **Has the Administration undertaken any studies to determine what the effect on atmospheric conditions will be if the Climate Convention is fully implemented by all signatories?**

A: The Administration has undertaken no independent studies of the effect of full implementation of the Climate Convention by all signatories. At this point, it

is difficult to know what each country is planning. However, we will understand better the quality and content of other countries' plans towards the end of this year, after Annex I (OECD countries and countries with economies in transition to market economies) Parties to the Convention submit their first official communications of their national policies and measures to the Secretariat in September 1994. To facilitate the review and make it more meaningful, the United States has jointly sponsored a process to work with other industrialized countries and countries with economies in transition to identify what information should be reported to allow rigorous review and to experiment with a practical (and low cost) process for the international review. Finally, the specific goal of the Climate Convention is to encourage action by signatories, not to require action. Consequently, full implementation of the Convention by signatories is no guarantee that signatories will be successful in taking the actions identified in their national communications.

FUELS CELLS

Q: **EPA is currently involved in a demonstration project at the Back River Treatment facility in Baltimore which combines both the goal of capturing methane from a landfill for energy utilization and promotion of fuels cells. These tandem goals of greenhouse gas capture and utilization of highly efficient, and clean, power generation are part of the President's Plan. Can you tell me how this program is progressing? Is EPA ensuring that this program is receiving the funding that was agreed to and will be completed on schedule?**

A: The feasibility study and preliminary design for this project have been completed. However, due to budgetary constraints and changing priorities, EPA does not have sufficient funds to complete the entire project as originally proposed. The Agency is now reviewing various options to determine how or whether to proceed with this project.

FUNDING PRIORITIES

Q: **OTA's report concluded that the current U.S. Global Change Research Program is more focused on understanding the causes for and rates of climate change than on examining the ecological and human impacts of change. Agencies such as EPA and the National Science Foundation involved in this adaptation research received less than 4 percent of the total funding for the Global Change Research Program. OTA concludes that since research on ecological and human impacts may take years or decades to produce results, the slow process may cost us the ability to respond to global change in areas that are especially at risk to irreversible damage. Do you agree that we need to redirect some of**

our funding priorities for some of the basic scientific research into adaptation research?

A: The U.S. Global Change Research Program (USGCRP) at the time the OTA report was written had a very strong emphasis on understanding global climate change and predicting the rates of future change. The OTA statement that "...EPA and the National Science Foundation involved in this adaptation research received less than 4 percent of the total funding...", however, should be clarified. The 4 percent refers only to the funding for impacts and adaptation research. The total funding for EPA and NSF in FY 1993 amounted to about 11 percent of the total funding for the Global Change Research Program. Recently, the USGCRP, with strong support from this Agency, has reorganized itself to give more focused attention to impacts, adaptation and mitigation issues, including the development of an integrated assessment capability for global change issues. The FY 1995 President's budget request for the total USGCRP program includes an increase of $55 million for research concentrated in these areas. The $55 million of new funds is included in the FY 1995 budget request for NSF. The need for a strong mission focus on producing a suite of research products that will support the policy development process has been recognized. Much work remains to develop strong, coordinated programs within these new areas of emphasis for the USGCRP, but this work has commenced. EPA has very recently been asked to lead the new USGCRP work group on "Analyzing Consequences, Adaptation and Mitigation." We expect the proposals of this work group to be reflected in the program in FY 1996 and beyond. EPA strongly agrees with the re-direction toward adaptation, mitigation, and impacts research, and senses a willingness of leadership of the USGCRP to work in a dedicated fashion to achieve this newly defined USGCRP objective.

QUESTIONS FROM SENATOR CHAFEE

Q: **Your testimony states that EPA has more than 1300 participants or "partners" for the voluntary Green Lights Program. EPA expects to increase that number to 2000 by the end of this year. The Green Lights program has been around for about 3 years now. At what point in the 5-year relationship does EPA determine that a participant is not meeting the obligations it agreed to in its contract with the government? What criteria would be used for such a determination? How would EPA remedy this sort of non-binding contractual violation? Has EPA ever dropped a participant from the program? At what point does a participant or future participant get to use the EPA Green Lights logo, or say that they are a participant for marketing purposes?**

A: In signing the Green Lights Memorandum of Understanding (MOU), the participant agrees to survey 100% of its facility square footage and to upgrade 90% of that square footage wherever profitable and wherever lighting quality will be maintained or enhanced. Green Lights staff provide technical assistance to each participant on an on-going basis. Such assistance includes regular telephone contact, review and discussion of implementation progress reports, on-site visits, and dissemination of technical manuals, computer software, and other technical materials. The participant agrees to report to EPA at least annually on its progress in meeting these commitments. EPA has developed an implementation progress report form for this purpose.

EPA sends a letter to each participant 2 months prior to each anniversary of joining the Green Lights program. The purpose of the letter is to congratulate the participant on its anniversary and to remind the organization to report if it hasn't already. If EPA does not receive a report (either on the EPA form or in an explanatory letter) by two months after the anniversary date, a reminder letter is sent. Subsequent reminder letters are sent every other month, each stronger in tone, requesting a report for that year. The fifth reminder letter, sent 10 months following the anniversary date, asks the participant to leave the program.

In addition, as participants "age" in the program, they are monitored with respect to their progress in meeting their MOU commitments. As participants pass their 3rd birthday, they are given additional review to ensure that they are on track for meeting their 5-year MOU commitments. If the participant is behind schedule, it is given priority status for implementration support.

Some participants, due to business downturns, loss of key personnel, or changing priorities, leave the Green Lights Program. The Program strives to retain commited organizations that are facing temporary setbacks, but does not resist when it is clear that continuing the Green Lights relationship is in neither party's interest. To date, about 30 organizations have left Green Lights.

Only after joining the Green Lights program by signing an MOU does EPA permit Green Lights partners to use the Green Lights logo for use on non-product specific material that will publicize the partner's participation in the Green Lights program. The partner agrees to use the Green Lights logo appropriately, and that such use does not constitute EPA's endorsement of the partner's products or services. Green Lights allies (organizations that are part of the lighting industry) agree to use the logo with an EPA disclaimer on any materials relating to its manufacture, distribution, or installation of lighting products or the provision of lighting-related services. Thus far, only one ally has been expelled from the program for misuse of the logo.

PREPARED STATEMENT OF SUSAN F. TIERNEY, ASSISTANT SECRETARY FOR POLICY, PLANNING AND PROGRAM EVALUATION

Mr. Chairman, Members of the Subcommittee, when I appeared before you and your full Committee last October 26 to present the President's Climate Change Action Plan, I promised to come back at your request and give you a progress report. With the Action Plan almost 6 months old and Earth Day a week away, it gives me great pleasure to appear before you today to bring you up to date on the activities of the Department of Energy in this arena.

When we view DOE's climate change activities over the past 6 months, we see several things: programs implementing policies enacted by the Energy Policy Act of 1992 and expanded by the Action Plan, and initial activities toward the development of new policy initiatives as announced in the Plan itself. I plan to talk about our overall progress, while Christine Ervin, the Assistant Secretary for Energy Efficiency and Renewable Energy, joins me today to address the implementation of climate-related actions by DOE programs.

TECHNICAL SUPPLEMENT TO THE CLIMATE CHANGE ACTION PLAN

Since we last met, the Framework Convention on Climate Change entered into force. As a consequence, the National Communication of the United States required by the Convention is due on September 21, 1994. The Administration expects the Climate Change Action Plan released last October to provide the cornerstone of this communication. This cornerstone will be greatly strengthened by our release last month of a document, coordinated with the Environmental Protection Agency (EPA), and the Departments of Agriculture and Transportation, that fully explains the analyses that underlay the President's decisions reflected in the Climate Change Action Plan.

I would ask that the document "The Climate Change Action Plan: Technical Supplement" be made part of the record to explain further the original Plan document. This Technical Supplement documents the assumptions and parameters used in analyses supporting the Action Plan. It is intended to meet the needs of government, private sector and independent energy and environmental analysts who wish to better understand the Plan, its analytical underpinnings, and the efforts that are needed for emission reductions to be realized.

The Technical Supplement describes the origins and context of the Climate Change Action Plan. It details the emission baselines for all the gases tracked in the Plan, the year-by-year reductions in emissions of each gas that are associated with each program in our plan, and other pertinent information for each of the proposed actions. A description of the integrating framework and a report detailing integrated modeling results for all energy-related actions are also provided. We believe this Technical Supplement will make the Plan more transparent and credible.

DOE'S INTERNATIONAL ROLE

The Department has also been actively involved with the Department of State and the EPA in the development of international reporting rules for the national communications required by the Framework Convention on Climate Change in order to assure transparency and consistency to enhance their usefulness. The policies underlying how much and in what format greenhouse gas information should be reported in these communications have been the subject of two recent international meetings, including the ninth session of the Intergovernmental Negotiating Committee (INC) this past February in Geneva. At this meeting, the U.S. position met with approval; namely, that all gases should be reported, that "sinks" should be included, and that global warming potentials may be used. We expect to continue to be actively involved on the U.S. team as we move forward to INC–10 and –11 and the first Conference of the Parties in March, 1995 in Berlin.

I would like to make the Subcommittee aware of a related environmental program in which DOE actively participates together with ten other agencies. Through the Country Studies program, we are making a concerted effort to help other nations who are signatories to the Framework Convention on Climate Change meet their commitments. Through this program, we will fund studies for up to 60 developing countries and countries in transition who do not have the financial, and often the technical, resources to develop their inventory of greenhouse gases, a requirement of the Convention. In addition to the inventory, we are encouraging nations to look at their vulnerabilities to climate change and possible adaptation measures in sectors such as agriculture and forestry, and to look at possible mitigation actions. A unique aspect of the Country Studies Program is the objective to build the capability to do climate work in the countries themselves. This leads to "buy in" from these

governments to take constructive action once they have a baseline inventory of their greenhouse gas emissions.

Finally, let me mention that during this past month, the Departments of Energy and State represented the United States at an international meeting on global climate change and energy policies, attended by the Energy Ministers of the member countries of the International Energy Agency. The Ministers' informed, off-the-record discussion focused on how nations are devising energy policies that will help enable their countries to meet their international climate change commitments. There was serious interest in our Climate Plan's innovative use of market-based strategies and government/private partnerships.

SECTION 1605(B) OF THE ENERGY POLICY ACT OF 1992

Reference is made in the Action Plan to voluntary reporting of some of the results of the individual actions. The Department of Energy, in consultation with the EPA, is preparing guidelines to allow for voluntary reporting of greenhouse gas emissions to the Energy Information Administration as authorized by Section 1605(b) of the Energy Policy Act of 1992. DOE has held six public workshops in which it solicited stakeholder views on a series of working papers in order to guide our efforts. Issues regarding the scope of the program (e.g., who can report, what gases can be reported, whether both source and sink projects are reportable) and the use of reference cases were two major topic areas. We plan to issue draft guidelines for public comment shortly and hope to have final guidelines published within this fiscal year. We expect the database that will eventually be created through companies' voluntary reporting of reduction strategies will be a source of valuable information on greenhouse gas reduction activities.

DOE STRATEGIC PLAN AND CLIMATE CHANGE

Now let me turn to another important activity underway at DOE, our strategic planning exercise, which is the overall priority setting context in which our critical climate change work is taking place. This strategic plan weaves the President's climate change priorities fully into the fabric of DOE's work. It is my pleasure to report that this document was released yesterday to the Congress and ask that it be placed in the record. This Plan was provided to all of our employees last week. Because this plan charts the Department's course for the 1990s, I would like to describe briefly this plan's purpose and overall contents, and then focus on the sections that relate to the Climate Change Action Plan.

The Department of Energy's priorities are changing in line with significant changes in the character of the Department's job. The end of the Cold War, the increasingly global character of our economic markets and environmental issues, and the public's desire for change as expressed by the election of President Clinton and Vice-President Gore, have brought on significant changes in the environment in which the Department of Energy operates. Secretary Hazel O'Leary challenged the Department's employees to think strategically about how best to deploy the Department's scientific and technological assets to help solve the country's changing needs. Our strategic plan is the result.

Through our strategic planning efforts, we identified five businesses that most effectively utilize and integrate our unique scientific and technological assets, engineering expertise, and facilities for the benefit of the Nation. These new businesses which directly affect the security and the quality of life of every American, are:

Industrial Competitiveness. Promoting economic growth and the creation of high-wage jobs through research and development partnerships with industry; driving products into the domestic and international marketplace; and, helping industry become more competitive by cost-effectively shifting from waste management to resource efficiency and pollution prevention.

Energy Resources. Encouraging efficiency and advancing alternative and renewable energy technologies; increasing energy choices for all consumers; assuring adequate supplies of clean, conventional energy; and, reducing U.S. vulnerability to external events.

Science and Technology. Using the unique resources of the Department's laboratories and the country's universities to maintain leadership in basic research; focusing applied research in support of the Department's other business lines; and, maintaining world technical leadership through long-term, systemic reform of science and mathematics education.

National Security. Effectively supporting and maintaining a safe, secure, and reliable enduring weapons stockpile without nuclear testing; safely dismantling and disposing of excess weapons; and, providing the technical leadership for national and global nonproliferation activities.

Environmental Quality. Understanding and reducing the environmental, safety, and health risks and threats from DOE facilities and decisions; and, developing the technologies and institutions required for solving domestic and global environmental problems.

We recognize that our organizational systems need realignment and integration so that we can most effectively produce results for the American people. We have identified four such critical success factors: Communication and Trust; Human Resources; Environment, Safety, and Health; and, Management Practices. Part of our plan indicates how we must do things differently in these four critical sets of systems in order to produce the results we hope to accomplish for the American people.

The strategic plan relates to the Climate Change Action Plan in two principal ways, through the Industrial Competitiveness and Energy Resources business lines. In both, we have developed visions, goals, strategies, and success indicators that address global warming issues.

Industrial Competitiveness. Industrial competitiveness requires partnering with industry and other Federal agencies to put the vast scientific and technological assets of the Department and its laboratories and facilities to the best use in advancing the U.S. position in a global market that is increasingly competitive. Continued scientific and technological innovation is the key to sustaining long-term economic growth to the year 2010 and beyond.

High-wage jobs will be created by economic growth based on technological innovation. At the same time, a cleaner environment, both here and abroad, will result from continued DOE-led research in energy and material efficiency for industrial processes. Industrial resource efficiency prevents pollution and increases competitiveness by improving overall process efficiency, while simultaneously helping to promote the knowledge-based jobs that are the key to enduring economic success. This technology strategy is also the key to sustainable development, which in turn is critical to our meeting our climate change commitments.

Energy Resources. A strategic energy policy is essential to promoting economic growth, high-wage jobs, and energy security while preserving the environment. Improving the efficiency with which the Nation uses energy is essential to reconciling these goals. Our strategy for efficient energy use is built on the foundations established by the Energy Policy Act of 1992, and is further supported in the Climate Change Action Plan.

Fossil fuels will remain critical components of energy supply in every nation for the foreseeable future. Domestically, coal, natural gas, and oil will continue to provide the majority of energy for electricity generation and for the commercial, industrial, and transportation sectors. We must focus on using these fossil fuels more efficiently and cleanly, reducing their contribution to global warming and ground-level pollutants.

The Federal Government can set an example for the Nation through the improved energy management of its buildings and facilities and through the wider use of energy efficient, alternative fuel vehicles. The President recognized this by signing a recent Executive Order, "Energy Efficiency and Water Conservation in Federal Facilities" (Executive Order 12902, March 8, 1994). The President's Climate Change Action Plan supports this Federal leadership, and will also provide a catalyst for mobilizing the public/private cooperation necessary to increase the use of energy efficiency and renewable energy.

LONG-TERM STRATEGIES, JOINT IMPLEMENTATION AND LEGISLATIVE ACTIONS

Before I turn to Christine Ervin to address program implementation of the Climate Change Action Plan, I would like to address the long-term and joint implementation strategies identified in the Action Plan and the two actions in the Plan that require legislation: (1) the "parking cash-out" action and, (2) the hydro leasing action.

Long-term Strategies. The Plan calls for the National Economic Council, the Office on Environmental Policy and the Office of Science and Technology Policy to co-chair a working group "to examine all budget, technology, R&D, regulatory and economic policies that could impact greenhouse gas emission levels beyond the year 2000." While this group is still in the information gathering stage, the Department expects to be actively involved as it moves to consider post-2000 possibilities. A similarly chaired working group will "develop measures to significantly reduce greenhouse gas emissions from personal motor vehicles." DOE is also participating in this working group.

Although the Climate Change Plan contains several measures to reduce greenhouse gas emissions from the transportation sector, the Plan recognized the need for significant, cost-effective, longer-term efforts to reduce greenhouse gas emissions

from automobiles and light-duty trucks. The Climate Plan directed three policy offices in the Executive Office of the President—the Office on Environmental Policy (OEP), the Office of Science and Technology Policy (OSTP) and the National Economic Council (NEC)—to co-chair a process, in consultation with other relevant agencies of the Federal Government, to develop policies to significantly reduce greenhouse gas emissions from personal motor vehicles in the years after 2000. The Department of Energy has been an active participant in the planning of this process.

We will soon announce the establishment of an Advisory Committee as the means to attempt to develop this consensus. The goals of the Advisory Committee will be to attempt to develop a consensus among major stakeholders on the sets of policies that would, if adopted, most cost-effectively return greenhouse gas emissions from cars and light trucks to 1990 levels within three optimal time frames (i.e., the years 2005, 2015, and 2025) with no upturn thereafter. The Advisory Committee will consider a broad range of policy alternatives, including policies affecting: (i) demand for personal vehicle travel; (ii) vehicle and fuel technology changes (including increases in vehicle and fuel system operating efficiency); and (iii) shifts in consumer choice among vehicle and fuel technology options. This dialogue will consider those policies that can be implemented by the Federal government, but such policies will be considered in the context of what can and should be accomplished at the State, local, and regional levels, and by private parties, both consumers and producers.

Joint Implementation. As you know, "joint implementation" refers to the provision in the Climate Convention that allows Parties to undertake their greenhouse gas commitments jointly with other Parties. Such joint implementation actions are a recognized approach in the Framework Convention. We are extremely excited by the large potential joint implementation has for combating the threat of global warming and for promoting sustainable development. The Administration is mindful of the many questions that have arisen about the details on how best to proceed on joint implementation projects. For this reason, the State Department has called for public comment on our U.S. Initiative on Joint Implementation, which was described in the Climate Change Action Plan. DOE is actively participating in the review of those comments and expects to be closely involved in providing technical assistance and in evaluating potential projects in this initiative.

The cooperation among agencies in these programs is also exemplary. For example, DOE, EPA and the State Department have set up integrated management teams on elements of the program that require daily interaction at the staff level.

Parking Cash-out. DOE is also involved in developing the "Cash-out" initiative, led by EPA and the Department of Treasury. This initiative will convert an existing parking subsidy targeted at employer-paid parking into an incentive for commuters to carpool, ride mass transit, or find other non-auto ways to work. Employees given subsidized parking at work will have the option of retaining the parking space or accepting a cash allowance equal to the market cost of the parking space. Commuters would then have the opportunity to "cash out" a fringe benefit, at no cost to their employers.

The Administration supports changes in the tax law necessary to bring about parking subsidy reform. The change will specifically require employers who pay for employee parking to also offer the choice of an equivalent (taxable) cash payment or (tax-free) transit pass. Certain businesses will be exempted, including small businesses and those for which employee parking costs fall below a de minimus level. In addition to the tons of greenhouse gas emissions that will be reduced as a result of this initiative, at least $650 million in new Federal revenue is expected to be raised through the year 2000.

Hydro Leasing. In the Climate Change Action Plan, the President directed the Administration to propose legislation to enable non-Federal developers to invest in environmentally sound upgrades at existing Federal hydroelectric projects and to sell the incremental power at market rates. Although significant technological potential exists for increasing generation at hydroelectric facilities, without changing streamflows, in the past, institutional barriers have stifled efforts to make these profitable efficiency upgrades. Investments to upgrade the efficiency of these facilities would increase generation at them, displacing fossil fuel-fired generation elsewhere on the grid.

In January the Department conducted a workshop with representatives of all stakeholders of this initiative. We received a great deal of positive feedback from industry, from environmental groups, and from taxpayer and public interest groups. Opposition was expressed by the public power groups. We have continued our discussions since that time and are committed to accommodating as many of those concerns as possible.

In the meantime we are moving ahead on two fronts. First, we are assisting in drafting legislation which the Administration hopes to submit to the Congress by the end of June. Second, we have requested reprogramming of funds to commence reconnaissance studies of existing Federal hydroelectric projects to determine the potential for upgrades. We are working with the Corps of Engineers, the Bureau of Reclamation, and the Power Marketing Administrations on both of these efforts.

We believe that the legislation that we are preparing will be a win-win proposal for all stakeholders. It will be a win for the environment because it will reduce greenhouse gas emissions. It will be a win for energy consumers because it will provide up to 2 gigawatts of new, cost-effective hydroelectric capacity. It will be a win for the economy of the communities in which these projects are located because it will stimulate investment of over a billion dollars. It will be a win for current Federal power customers because it will reduce their power costs by reducing operating and maintenance costs, improving reliability, and extending the life of the improved facilities. In addition, Federal power customers will continue to receive, under the existing pricing structure, all of the hydroelectric power they currently receive. Finally, this initiative will be a win for taxpayers because it will generate non-tax revenues for the Treasury from lease payments by developers. These revenues will help reduce the deficit.

CONCLUDING REMARKS

In closing, some concern has been expressed that recent economic and energy market conditions would make it more difficult to reach the 1990 target level by the year 2000 under the Plan as currently structured. While this plan was predicated on assumptions about the future and about the impact of programs, it was also designed to be responsive and adaptable to changing circumstances. Specifically, we committed to periodic assessment, review, and, if necessary, expansion. However, the timetable for such review reflects the need to discern short run fluctuations from changes in longer term trends, and we are currently assessing the implications of recent shifts in market conditions on our forecasted levels of emissions. At the same time, we are committing our resources and energy to implementing the ambitious slate of programs currently identified. We continue to have confidence that our programs will continue to be effective provided we receive strong Congressional support for our Fiscal Year 1995 budget request. Finally, we realize that future economic and energy market conditions may require additional actions in order to return greenhouse gas emissions to 1990 levels by the year 2000. The magnitude of any potential shortfall, however, is in the process of being analyzed, and we are continuing to identify additional actions that may be utilized to address any shortfall. We stand committed to meet the President's Climate Change goal.

My comments to this point have been directed primarily at the policy-driven climate activities of the Department. Once policies have been determined, it is the responsibility of the program offices to turn them into reality, into meaningful programs that can deliver a reduction in greenhouse gas tons. To that end, our program offices have developed detailed implementation plans to carry our climate policies forward. Assistant Secretary Christine Ervin will now address the activities of the program offices in this regard. Following her statement, I will be happy to answer any questions you may have.

PREPARED STATEMENT OF CHRISTINE A. ERVIN, ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

Mr. Chairman, Members of the Subcommittee, I am pleased to appear before you today to report on the substantial progress we have made towards implementing the President's Climate Change Action Plan.

As Assistant Secretary Tierney has just stated, it was 6 months ago that she appeared before this Subcommittee and testified that the Department of Energy would produce an implementation strategy for the Climate Change Action Plan. Secretary Tierney pledged that this implementation strategy would contain "milestones and metrics" that would enable observers to gauge whether our Plan was working in each successive year, so that we will not approach the year 2000 without a clear sense of whether our Plan is achieving its target.

In the Office of Energy Efficiency and Renewable Energy, we have the direct responsibility to implement almost half of the Climate Plan—21 out of 46 total actions. We have made the Climate Plan our highest planning priority, and we have been working towards implementation almost since the day the plan was issued. We have developed an implementation strategy that is extremely comprehensive and flexible, and allows us to examine and adjust our portions of the Climate Plan as

we observe which are more successful than others. Each of our 21 individual implementation plans has embedded milestones and metrics. We fully expect to be able to report our progress to the Congress, and to the American People, periodically.

Two other Department of Energy offices have responsibility for three additional actions in the hydropower and gas technology areas. The Office of Policy, Planning and Evaluation and the Office of Fossil Energy are planning for aggressive implementation of these actions.

In my testimony today, I will explain to you the principles and the process we have used to design our Implementation Plan, and why we believe our implementation strategy is flexible and robust. Before I do this, however, two introductory points are in order.

First, up to this moment the vast majority of our efforts towards implementing the Climate Change Action Plan have been planning rather than implementation itself. Although we have the legislative authority to carry out the plan, we will have no appropriated funds for implementation until FY95. It is our intent to use the time period between the release of the plan and the beginning of FY95 to ensure that our implementation planning is careful, comprehensive, and ready to execute as soon as possible in FY95. The preliminary result of this effort are the detailed draft program plans which have been provided to the staff of this Subcommittee.

My second point has to do with our ability to calibrate and adjust our programs as we observe our progress between now and the year 2000. We have a very large and diverse group of programs, and it is likely that some programs will exceed their target while others lag behind. Our implementation framework allows us to shift resources towards markets and programs that show greater potential on an annual basis, after careful evaluation and deliberation. We believe that our implementation strategy provides additional assurance that the President's Plan will effectively reduce greenhouse gas emissions, assuming Congress supports implementation of the plan as we have designed it.

BACKGROUND

The Climate Change Action Plan (CCAP), announced by the President on October 19, 1993, represents a set of programs designed to meet the Administration's simultaneous goals of creating jobs, decreasing energy costs for homes and businesses, and fulfilling our national commitment to reduce greenhouse gases to 1990 levels by the year 2000 without harming economic growth.

The twenty-one programs in the CCAP that are the primary responsibility of the Office of Energy Efficiency and Renewable Energy are almost entirely drawn from authorities under the Energy Policy Act of 1992 (EPACT) which to this point have been implemented at a modest pace. As a result, the CCAP should be viewed largely as a set of newly or more aggressively implemented EPACT programs. We use the acronym "EPACT/CCAP" to emphasize this point.

OUR PROPOSED EPACT/CCAP PROGRAMS ARE DESIGNED TO AVOID CREATING NEW OR DUPLICATIVE BUREAUCRACIES

Beyond our integration efforts, the programs in this implementation plan reflect a set of "design principles" meant to ensure that each program is likely to be cost-effective and can be monitored, adjusted, altered or terminated as needed, so as to meet our overall economic and environmental objectives. The principles are:

- Maximum use of existing deployment mechanisms;
- Integration with on-going programs;
- Extensive involvement of stakeholders in program design;
- Tracking and measurement of program success;
- Leveraging of additional resources through public-private partnerships; and
- Flexibility for varying geographic and market circumstances.

These design principles are essential if government deployment programs centered on voluntary, cost-effective energy efficiency measures are to be successful.

BUILDING ON EXISTING DEPLOYMENT MECHANISMS AND LEVERAGING DOLLARS

These principles serve as a reminder that any one of our programs is generally not the only or even the largest deployment influence on the energy marketplace. State Energy Offices, electric and gas utilities, local and county governments, community action agencies, other Federal agencies, and many other groups have been operating deployment programs for many years. These programs vary in scope, objective, and effectiveness, and each can play a significant role in deployment. These programs exist now and represent an enormously powerful infrastructure. As an ex-

ample, electric utilities presently spend over $2 billion per year on energy efficiency programs.

A key component of our action plans is the emphasis which it places on public/private partnerships. From the golden carrots, market-pull activities to the renewable energy collaboratives, each plan is contingent on the full partnership of outside constituencies. This partnership approach makes smart use of limited Federal resources while improving program effectiveness by working directly with industry and other constituencies to identify the real barriers to deployment of efficiency and renewable energy technologies.

We seek also to induce competition between existing programs so as to improve all of the programs, not just the ones who win the contest and receive our assistance. As a condition of working with us, we propose to require that existing programs use "best practices" and allow us to ensure that the cost-effectiveness of our activities are clearly measurable. To serve regions of the country where no programs presently exist, and to foster greater competition, we allow for start-up programs to participate as well.

OUR EPACT/CCAP PLANS ARE CAREFULLY INTEGRATED WITH OUR EXISTING BASE PROGRAMS

The original specification of the CCAP initiatives was intentionally flexible in order to accommodate refinements and integration as detailed implementation proposals were developed. Consistent with the guidance of Secretary O'Leary, energy efficiency has invested an enormous effort to ensure that our implementation plan is well-integrated with our ongoing or "base" programs.

To understand our integration and coordination effort, note that our base programs increase energy efficiency and the use of renewables by investing in activities that span all parts of the product life cycle, from research at the front end to activities involving mature technologies and markets. Many of our base programs are applied R&D, which means they assist industries with the development of new technologies, though several significant base programs (e.g., weatherization and the Federal Energy Management Program [FEMP]) increase energy efficiency by deploying mature technologies.

The EPACT/CCAP programs discussed in this implementation proposal are primarily intended to act towards mature technologies. We have integrated the EPACT/CCAP programs with our base. All proposed programs address the impediments to greater use of efficient and renewable technologies without drawing artificial boundaries between base and new programs and do not duplicate existing Federal or state efforts. For example, though our Weatherization program and the Federal Energy Management program are not officially a part of the CCAP, both complement the newer programs. In calculating the size and scope of the EPACT/CCAP effort, existing programs such as FEMP and Weatherization grants were assumed as current contributors to greenhouse gas reduction and greater energy efficiency. With these assumptions in place, the target sectors for achieving enhanced emissions reductions were identified. Each new EPACT/CCAP program was then carefully designed to leverage these existing programs as well as outside resources.

The general program design process began by dividing the energy marketplace into submarkets or segments and studying the barriers to energy efficiency and renewable energy in each segment. We then examined how existing energy efficiency and renewable deployment programs in each segment work and devised a strategy designed to address market barriers in a cost-effective manner.

MAXIMIZE STAKEHOLDER INVOLVEMENT

The third design principle is the involvement of our stakeholders, in the design of the programs as well as their implementation. Early stakeholder involvement and support for the initiatives is key to the success of the entire program. Because we seek to leverage our resources and use existing deployment mechanisms, the involvement of outside groups takes on an importance unprecedented in the Department's programs.

Key participants in this effort have been the various representatives of the State Energy Offices throughout the country. In addition to the States, local government and regulating officials are working with us and with industry to design the best approach to accomplish the goals of each action item.

To facilitate stakeholder communication and accelerate the program development process, the Office of Energy Efficiency and Renewable Energy created a coordination center called the Green Room. The Green Room facility embodies Secretary O'Leary's new way of doing business and the Administration's efforts to reinvent government. Through this facility, program managers share information about Plan

initiatives, coordinate with one another, brainstorm creative solutions, and seek input from industry, regulators and local government representatives. State Energy Offices have loaned personnel to the effort, thus leveraging additional resources. This co-location of personnel is designed to foster the coordination and focus needed to develop effective, targeted programs as swiftly as possible.

To further increase stakeholder involvement, we are hosting a series of workshops around the country to solicit input from States, localities, industry, utilities, non-profit organizations and others. By taking the plan beyond the Washington, DC area we hope to receive a variety of views which reflect the regional diversity of our constituency. To date, we have received excellent input that will substantially improve the effectiveness of these programs.

TRACKING AND MEASURING PROGRAM PERFORMANCE IS BUILT IN TO THE DESIGN

Performance measurement, including milestones and metrics, for CCAP actions is one part of an on-going effort within the Office of Energy Efficiency and Renewable Energy to establish Quality Metrics for all of our programs. The overarching result we seek from our portion of the CCAP actions include: $50 billion of private capital investment by the year 2000, greenhouse gas emission reductions of nearly 40 million metric tons and energy cost savings of $30 billion by the year 2010.

The measures of success we propose for the individual CCAP implementation plans include the long term impacts of the program on the economy, such as capital investment generated and energy productivity; energy, for example, energy savings and renewable production; environment, such as the amount of carbon and waste reduction; and equity, to include incidence of cost and benefit, demographic impacts and risk.

We also propose short term indicators such as: progress toward program objectives, market penetration and assessments, client satisfaction, changes in public opinion, cooperation and coordination. As appropriate, we propose to measure: new technology developed from R&D; workshop, seminar and information/education results; partnerships and replications from demonstrations; applications of technical assistance; observations of adoptions from regulations and standards; intergovernmental agreements; response to incentives; and cites or interactions from communications.

Milestones and metrics are included in each action implementation plan. Including the need for this information in the program design will enable us to report to you in subsequent years on the progress we are making and on the very specific benefits of our work. We propose to monitor a variety of factors which together should keep us well on track with our objectives.

FLEXIBILITY FOR VARYING GEOGRAPHIC AND MARKET CIRCUMSTANCES

The final guiding design principle was to keep in mind that what works in one part of the country or in one segment of the market may or may not work in another. These actions are carefully designed to build solutions to market impediments with as much flexibility for differences as possible. The CCAP actions target specific segments of the energy use sectors with different approaches. Taking advantage of the stakeholder partnerships to accurately define the idiosyncrasies of the problem in the design process has proven to be an effective tool to provide our plans with the necessary flexibility.

SUMMARY AND CONCLUSION

In closing, the EPACT/CCAP programs in this implementation proposal have been carefully designed to complement our existing programs and complement each other. In some cases, reading the text of individual implementation plans one by one does not adequately illustrate the amount of integration and comprehensive planning embodied in our proposal.

EPACT and CCAP together represent an important attempt to demonstrate the significance of pursuing cost-effective commercialization and deployment activities to make our economy more efficient, create jobs, and meet important environmental commitments. The Office of Energy Efficiency and Renewable Energy recognizes that the design of cost-effective deployment programs in an era of enormous Federal budget pressures demands that we carefully target and account for our efforts. Each of the individual programs that follow carefully articulate their objective and their strategy for achieving their objective. We recognize that only through such major planning efforts will we create, in the most reliably and objective manner, programs that meet the Administration's broadest economic and environmental goals.

With respect to the Federal budget, let me repeat the points that Sue Tierney made. We are eager to implement the Climate Change Action Plan and to succeed

in meeting the President's objectives to achieve the emissions reduction goals. To accomplish this we are counting on the Congress to provide the bulk of the amount requested in the President's budget for Climate Change programs. We respectfully ask for your help to achieve this goal.

Let me repeat another point which Sue Tierney made concerning the possibility that we may have difficulty achieving the President's goals because of declining oil prices, changes in economic growth and other factors. We have a good deal of confidence in the plan that we prepared. That plan notes that we will make changes as circumstances warrant. We are reviewing comments by various groups who are skeptical about the prospects of our success. We need time to digest these criticisms. We look forward to working with you on any changes which may be needed.

Thank you for the opportunity to present this testimony. I am happy to address any questions you may have.

Department of Energy
Washington, DC 20585
July 6, 1994

The Honorable Joseph T. Lieberman
Chairman
Subcommittee on Clean Air
and Nuclear Regulation
Committee on Environment and Public Works
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

On April 14, 1994, Susan F. Tierney, Assistant Secretary for Policy, Planning and Program Evaluation and Christine A. Ervin, Assistant Secretary for Energy Efficiency and Renewable Energy testified regarding the Administration's Climate Change Action Plan.

Enclosed are the answers to the questions submitted by you and Senator Chafee for the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Renee Wilhite, on (202) 586-4273.

Very truly yours,

William J. Taylor, III
Assistant Secretary
Congressional and Intergovernmental
Affairs

Enclosures

QUESTIONS FROM SENATOR LIEBERMAN

Question 1: It is my understanding that EPA and DOE have both been denied requests to reprogram a certain amount of funds for 1994 to the implementation of the Plan. How will this affect implementation? Do the denial of these funds indicate a disagreement on the part of the Committee leadership with the agencies' approaches?

Answer: The effect of the denial of the DOE reprogramming request will be to slow down Climate Change Action Plan initiatives that are ready to start. This will result in greater difficulty in reaching the greenhouse gas reduction targets in the Plan. For example, the Motor Challenge is poised to begin and now must wait another six months before it can start. Implications for this program include lower emissions savings by 2000 and over 50 disappointed industrial companies who had signed up as partners to begin demonstrations at their expense. In addition, the Climate Wise program to facilitate voluntary reductions by industrial firms will be unable to start until the next fiscal year - delaying the associated emissions reductions for at least six months.

The reprogramming request denial, however, does not represent a disagreement between the committees and DOE on the Climate Action Plan or its implementation planning effort. Rather, it reflects the committees reluctance to fund what they consider to be "new starts" for FY 1995 from even limited FY 1994 funds. However, most of the funds are for programs that were authorized by the Energy Policy Act, which we did not regard as "new starts".

QUESTIONS FROM SENATOR LIEBERMAN

Question 2: Are there ways for industry to contribute to some of these voluntary programs to help ease some of the funding problems. For example, could some of the industries that have successfully completed EPA's Green Lights program help provide technical assistance to other companies?

Answer: The Climate Change Action Plan programs are being developed to maximize private-sector participation. Companies and public interest groups are contributing time and money to reduce their own greenhouse gas emissions and to help DOE find existing deployment channels for the programs. We expect that state and local government, private industry and utility partners will substantially outspend federal agencies in the implementation of these programs by at least 10 to 1. We anticipate that some state and local governments, companies and utilities will exchange some information and experience with others as a condition for participating. However, such exchanges are already assumed in the Climate Change budget request.

Question 3: What percent of the financial responsibility for implementing the Plan is assigned to each of the implementing agencies?

Answer: Based on the Fiscal Year 1995 request, DOE is responsible for funding approximately 63 percent of the Plan, EPA 33 percent, USDA 3.7 percent, and other Federal agencies .3 percent.

Questions from Senator Lieberman

Fuel Economy

Question: The Plan calls for a process to be completed by October to develop measures to significantly reduce greenhouse gas emissions from cars and light trucks including measures to improve fuel efficiency by 2 percent per year over a 10-15 year period. EPA is a co-chair of this process.

What progress has been made in this effort? What is EPA's role in the Task Force? How does it relate to the Clean Car initiative?

Answer: A Federal Register Notice was issued on April 14, 1994, announcing the formation of a Policy Dialog Advisory Committee to Assist in the Development of Measures to Significantly Reduce Greenhouse Gas Emissions from Personal Motor Vehicles. The Notice included the charter for this Federal Advisory Committee and a request for nominations for membership. The Department of Energy, the Department of Transportation, and the Environmental Protection Agency are all participating in this project with three White House Offices: the National Economic Council, the Office of Environmental Policy, and the Office of Science and Technology Policy. A copy of the Federal Register Notice is attached.

The "Clean Car Initiative" (Partnership for a New Generation of Vehicles) differs significantly from the policy development process that the formation of the Advisory Committee commences. The Clean Car Initiative

launches a series of Cooperative Research and Development Agreements (CRADAs) that will result in substantial advances in motor vehicle technologies. While the new policy development initiative will carefully consider the benefits of these CRADAs to reduce greenhouse gas emissions, a wide range of other policies that can reduce greenhouse gas emissions will also be considered.

Questions from Senator Lieberman

Climate Challenge Program

Question: When will guidelines be promulgated for section 1605? Will one of the guiding principles in these guidelines be to ensure accuracy in recording of reductions?

Answer: The draft guidelines were issued for public comment on June 1, 1994. Given the volume of comments that are anticipated, we hope to announce the final guidelines in early Fall, 1994.

The draft guidelines call for the identification of data sources and methods used by the reporter in estimating the level of emissions and gases that are sequestered from the atmosphere. The reporter is also required to certify the accuracy of the reported information. Thus, the accuracy of data provided in the voluntary reports can be developed from the recorded information.

We will be looking at the reported results based on information gathered through other avenues such as the original commitments of participating utilities, and filings before regulatory bodies. Where significant issues in reporting arise, these will be reviewed with the reporting parties.

QUESTIONS FROM SENATOR LIEBERMAN

Question 6: What type of emission reduction commitments have been obtained from the utilities who have agreed to participate in Climate Challenge? Will all the commitments actually result in net reductions rather than simply curbs of net emissions increases? How will DOE ensure accountability in this program? Will utilities be required to provide annual auditing of their performance?

Answer: During "Earth Week," utility trade association representatives signed an industry-wide agreement establishing the framework for the Climate Challenge program. To date, more than 700 publicly-owned electric utilities, more than 90 investor-owned electric utilities, and more than 100 rural electric cooperatives have sent letters expressing interest in working with DOE on the Climate Challenge program. Utilities have agreed to enter into specific agreements as soon as the guidelines for accounting for and reporting their reductions are finalized this fall (per the EPACT 1605(b) Voluntary Greenhouse Gas Reporting provision). These utility-specific commitments will be developed as the next phase of the Climate Challenge program. It is anticipated that each utility will make one of six commitments, ranging from reducing greehouse gas emissions or from a historic baseline to reducing anticipated emission increases. More than 60 utilities have expressed interest in participating in joint industry-sponsored initiatives that have been developed as a result of the Climate Challenge program. These initiatives include: 1) the National Earth Comfort Program - a proposal for an industry-government geothermal heat pump consortium, 2) the electric utility industry's electrotechnology and renewable energy investment pool, 3) the Utility Forest Carbon Management Program

and the TREE POWER program, 4) EV America -- an electric vehicle market demonstration program, and 5) the International Utility Efficiency Partnership Program. In addition to the joint initiatives, a Climate Challenge options workbook is being developed -- the workbook describes numerous steps utilities can take to reduce greenhouse gas emissions in order to meet their Climate Challenge commitments.

DOE's Rebuild America (expands markets for energy-efficient technologies in commercial and multi-family buildings) and it's Renewable Energy Market Mobilization Collaborative and Technology Demonstration action (accelerated market acceptance of renewable technologies) for example will result in projects that slow the rate of emissions. On the other hand, one of DOE's industrial actions that is aimed at increasing market penetration of energy efficient industrial electric motor systems, Motor Challenge, could result in absolute emissions reductions. Most energy efficiency actions will slow the rate of emissions growth. DOE plans to use the voluntary reporting system (in accordance with EPACT Section 1605(b)) these reports to ensure that companies are reducing their greenhouse gas emissions consistent with their Climate Challenge commitments.

The DOE Office of Energy Efficiency and Renewable Energy (EE) has developed proposed program evaluation metrics for Climate Challenge. These metrics include carbon emissions, energy savings/production, investment and employment for longer-term outcomes, and for near-term outcomes: partner participation, customer satisfaction, and percent infrastructure complete for

Questions from Senator Lieberman

Effect on Atmospheric Conditions

Question: Has the Administration undertaken any studies to determine what the effect on atmospheric conditions will be if the Climate Convention is fully implemented by all signatories?

Answer: No studies specific to this question have been carried out. The Convention does not include any required numeric emissions reductions for any Party but, rather, requires the Parties to report how they are limiting their annual emissions and expanding sequestration of gases from the atmosphere.

Many of the Annex I countries of the Convention (Developed countries and the countries with their economies in transition) have made obligations to reduce their emissions by an amount roughly similar to the "aim" of the Convention, that is to, as a first step, return their annual emissions by year 2000 to 1990 levels (Article 4, Paragraph 2b). Even if all such signatories were to fully implement policies that would meet this aim, atmospheric concentrations of greenhouse gases will continue to increase.

We, together with other Departments and Agencies, intend to continue analysis on the effects of GHG's in the atmosphere and modeling to improve our understanding of various levels of global concentrations of GHG's.

QUESTION FROM SENATOR CHAFEE

Funding Priorities

Question: OTA's report concluded that the current U.S. Global Change Research Program is more focused on understanding the causes for and rates of climate change than on examining the ecological and human impacts of change. Agencies such as EPA and the National Science Foundation involved in this adaptation research receive less than 5 percent of the total funding for the Global Change Research Program. OTA concludes that since research on ecological and human impacts may take years or decades to produce results, the slow process may cost us the ability to respond to global change in areas that are especially at risk to irreversible damage.

Do you agree that we need to redirect some of our funding priorities from some of the basic scientific research into adaptation research?

Answer: The U.S. Global Change Research Program (USGCRP) has carefully developed priorities for understanding and predicting global climate change, and programs of the USGCRP are already focused on critical scientific needs. There is essentially no flexibility for redirecting scientific funds to adaptation studies without seriously impacting scientific products needed to assess both physical and biological impacts of climate change. Additional resources are needed to address the range of adaptation issues identified in the OTA Report.

The USGCRP has recently placed more emphasis on potential impacts and consequences of global change, and limited additional resources have been requested in the President's FY 1995 budget to address priorities related to these issues. Part of the request for the NSF "global change" budget in FY 1995 will be devoted to

terrestrial ecology research, and to human dimensions and policy analysis. The full interagency Global Change Program will be engaged in the implementation of this program if it is approved by Congress.

In addition, it should be recognized that agencies participating in the USGCRP already carry out research on selected effects of greenhouse gases and climate change on biological/economic systems. While not necessarily targeted on adaptation, the programs are developing the capability of examining regional scale impacts/consequences/response strategies, etc. In the Department of Energy (DOE), for example, both field and modeling programs are designed to improve scientific foundations, and to provide regionally resolved climate models. Specific studies of DOE's Program on Ecosystem Research and Vegetation Response to CO_2 and Climate provide an understanding of ecological processes needed for modeling adaptation responses. Therefore, research relevant to adaptation issues does indeed exist in some components of the USGCRP, and this fact may have been overlooked by the OTA study.

Questions from Senator Chafee

Question 1: The recent reports from the Energy Information Administration on higher-than-anticipated 1993 levels of energy sector carbon emissions and the impact such findings could have on our ability to meet reduction targets for the year 2000 is, potentially, an interesting dilemma.

I read that some analysts are projecting a 48% increase in global energy consumption by the year 2010.

Will substantial domestic manufacturing increases, and increased use of the fuel to power such growth make more difficult our ability to meet the President's reduction goals? Is there room in the Plan for unanticipated emissions increases?

Answer: The reports which you refer to showing rising emissions were prepared by private groups using recently-published Energy Information Administration (EIA) data. The EIA has not yet released its 1993 annual inventory of greenhouse gases. The level and composition of economic activity, along with energy prices, weather conditions, and the market penetration of energy efficient technologies, is an important driver of the demand for energy. Energy-related emissions depend on the mix of energy resources used to meet this demand.

The Climate Change Action Plan incorporates assumptions regarding economic activity that are consistent with current Administration forecasts. Holding other influences such as energy prices and weather constant, a persistent trend of unexpectedly strong economic growth, while generally welcome, would tend to increase

energy use and emissions above projected levels. While the Action Plan does not provide "room" for unanticipated emissions increases, it does incorporate a periodic review mechanism to consider any adjustments that may be necessary in light of economic trends and other developments.

Questions from Senator Chafee

Question 2: The TORONTO STAR reported a story 3 days ago which was startling. Canadian researchers who have been funded by their government to observe hydroelectric dams have concluded that some dams apparently create reservoirs which produce vast clouds of methane and CO2. They estimate that such a hydroelectric reservoir emits nearly as much greenhouse gas as an electric generator powered by fossil fuel.

Do you have any information on this? Has this report been reviewed by anyone here?

Answer: While we have not reviewed the report, we understand that a recent study in Canada concludes that net emissions of carbon and methane from upland forests and peatlands flooded during construction of hydroelectric projects may, if the reservoir is very large in proportion to the power generated, rival those from fossil-fueled power plants.

It should be noted that the conclusions of this study are not applicable to the Administration's proposal for increased hydroelectric generation at existing dams. Our proposal would not create any new dams or reservoirs. We propose to make cost-effective improvements to existing facilities resulting in more efficient use of the resource. The increased hydroelectric generation at each improved facility will not result in emissions of greenhouse gases. Greenhouse gases will be reduced because the increased

hydroelectric generation will reduce the need for electricity generation from other sources including from fossil fuels.

Questions from Senator Chafee

Question 3: Has the Administration put into place a legislative strategy for the action item involving upgrades of hydroelectric facilities?

Will we be able to make up for the losses in raised revenue and emission reductions from this action item if necessary legislation is not adopted this year?

Answer: Staff from the Department of Energy have been working closely with other Federal agencies and representatives from the public and private power industries to develop proposed legislation that will accomplish the goals of the hydroelectric initiative in the Climate Change Action Plan while protecting the current deliveries of power to preference customers. We have an overall implementation plan for coordinating the preparation of the legislation and for commencing a reconnaissance level study of all existing Federal hydroelectric facilities to determine the potential for upgrades at each facility. In brief, the implementation plan includes the following activities:

- The Department conducted a meeting on January 12, 1994 for all potential stakeholders in order to obtain their input on the proposal.
- We have continued to meet and discuss the proposal with interested groups to exchange ideas and resolve potential issues.
- We have requested reprogramming of $400,000 to commence a reconnaissance level study of the

upgrade potential at existing Federal hydroelectric facilities. We will begin the study as soon as the reprogramming is approved.

- We anticipate that we will submit legislation to Congress in the near future.

We do not anticipate significant revenues from the hydroelectric initiative until 1998-2000, and it is possible that we would still be able to meet this schedule if the legislation is not passed this year. However, timely approval of the Department's pending request for reprogramming of funds is needed to commence the study of existing Federal hydroelectric facilities. Further, some upgrades would be unnecessarily delayed if legislation is not approved this year. The potential for improvements has already been confirmed at some projects and bids for this work could be solicited immediately.

PREPARED STATEMENT OF DR. STEPHEN P. LEATHERMAN, DIRECTOR AND PROFESSOR, LABORATORY FOR COASTAL RESEARCH, UNIVERSITY OF MARYLAND

RISING SEA LEVEL AND COASTAL VULNERABILITY

EXECUTIVE SUMMARY

- Sea level rise can be thought of as the "dipstick" of climate change.
- Sea level is already rising in response to global warming.
- Coastal impacts are evident: beach erosion is a national problem.
- Global warming will most likely increase the intensity of hurricanes.
- Coastal areas are urbanizing at more than twice the national rate; much of the nation's economic wealth is located along coastlines.
- Sea-level rise is predicted to increase worldwide by as much as a meter (3.3 feet) by the year 2100, compared to a rise of 18 cms (6 inches) during the past century.
- The coast is a collision zone: sea-level rise is pushing the shore landward at the same time that rapid coastal development is occurring, greatly increasing the inherent vulnerability.
- Sea level rise is perhaps the most dramatic and certain impact of global warming.

INTRODUCTION

A significant portion of the U.S. population lives within the coastal zone, with many buildings and facilities built at elevations less than 10 feet above sea level along the shoreline. Presently, many of these structures are not adequately above existing water levels or located far enough landward to ensure their survival and the safety of residents during major storm activity. This hazard has grown increasingly apparent and serious along much of the U.S. Atlantic and Gulf coasts, particularly the highly urbanized sandy barriers, as relative sea levels have risen during the twentieth century.

Changing sea levels have been the driver of shorelines over geologic time, approaching 400 feet below present levels approximately 15,000 years ago during the Ice Age. Resort areas, like Ocean City, MD, would have been over a 100 miles landward of the shoreline at this time as the seas receded to the shelf edge, exposing the wide continental shelf. With retreat of the glaciers, the water incorporated in these huge ice sheets, which had extended as far south as northern New Jersey, was released to again start filling up the ocean's basins.

The general effect of sea level rise on coastal lowlands is to induce landward retreat—beaches erode and marshes are lost. Most sandy shorelines nationwide have experienced recession during the past century; historical data indicate that over 70 percent of our sandy beaches are eroding. Along the U.S. Atlantic and Gulf coasts, the relative rise has averaged about one foot per century, which corresponds to a horizontal beach retreat of several hundred feet per century. In fact, historical shoreline movement studies have shown that many Atlantic coast barrier beaches are eroding at rates of 2 to 3 feet per year (200–300 feet per century). Rates of erosion along the Louisiana coast are reported at 30+ feet per year during historic times, largely because of rapid land subsidence. Accelerated sea level rise due to greenhouse-induced global warming will only increase erosion rates and exacerbate the present shoreline dilemma.

Since sea level is a basic consideration for coastal construction, planners should consider the change in sea level that may occur during the useful life of a building. Also, sea-level rise results in beach erosion so that setbacks for beachfront houses and hotels should also be established based on the historical record and future projections.

For nearly a century, sea level has steadily risen at most tide-recording stations nationwide and around the world. At the same time the atmospheric concentration of greenhouse gases has shown a steady increase, and global temperatures have risen about 1°F in the last 100 years. While it is still being debated if the greenhouse effect is responsible for the observed warming trend, it is clear that sea-level is rising. Over the long term, global warming and sea-level position must be linked. Although some politicians and the public are unaware of or have largely ignored these warnings, the evidence for global change and its impacts is mounting. The relevant facts include the following:

- The greenhouse effect is what makes the Earth habitable to life; this contrasts with freezing conditions on Mars and metal-melting conditions on Venus with much lower and higher concentrations of carbon dioxide, respectively.

- The concentrations of carbon dioxide and other greenhouse gases are rapidly increasing in the atmosphere.
- World temperatures are rising (about 0.5°C (1°F) in the last 100 years). The 1980s was the warmest decade on record.
- Regardless of future emission policy, further global warming is inevitable due to the greenhouse gases already emitted (i.e., there is already a "commitment" to global warming), and adaptation measures will most likely be required.
- Only the most extreme emission policy for greenhouse gases can actually stop, as opposed to slow, continued global warming beyond that which is already inevitable.
- Water expands when heated; thermal expansion of near-surface ocean waters as well as melting of land-based glacial ice will increase sea levels.
- Mid-latitude glaciers have retreated on average during the 20th century (releasing their ice-locked water to the ocean).
- Relative sea levels have risen at most tide gauges in the last century; the eustatic (worldwide) contribution is estimated to be about 6 inches during the last century. Along the U.S. East Coast, land subsidence has equaled the worldwide trend so that the relative sea level rise has totalled one foot during the last century.
- Sea-level rise and shoreline recession are directly linked as shown by laboratory experiments and erosion problems in the Great Lakes region during periods of high water levels.
- Shorelines are retreating on a global basis; approximately 70 percent of the sandy beaches worldwide are presently eroding. In the U.S. best estimates are that 70 percent to 90 percent of sandy beaches are eroding.
- Global warming will most likely increase the intensity of hurricanes, which have the greatest impact on low-lying coastal landforms and the area's inhabitants by inducing massive erosion and flooding.
- There is a worldwide trend of coastal urbanization; over 50 percent of the U.S. population live in the coastal zone, which is urbanizing at more than twice the inland rate. A disproportionate share of the nation's economic wealth is located along coastlines; beachfront property is some of the most expensive real estate in this country.
- Sea-level rise is predicted to increase worldwide by as much as one meter (3.3 feet) by the year 2100 based on business-as-usual emissions; best estimates are for a two foot rise with at least a one foot eustatic increase within the next century.
- Global environmental problems are intensified in the coastal zone; sea level rise is pushing the shore landward at the same time that population growth and coastal urbanization are rapidly increasing.

Of all potential impacts of human-induced climate change, a global rise in sea level appears to be the most dramatic and certain impact. In fact, sea level can be thought of as the "dipstick" of climate change. Rising sea-levels and growing coastal populations are already placing increasing strain on the coastal zones of the world. Societies can plan for sea-level rise impacts because at least we know the direction if not the degree of the increase. In addition to the practical value of sea-level rise research, public awareness and understanding of the scale and magnitude of future changes can be promoted because people can identify with beach erosion and building loss.

SEA LEVEL RISE

Sea-level change measured at any location is a relative change between the sea and land surfaces. Therefore, the relative change is the sum of eustatic or worldwide sea level change and the vertical movement of the land surface at that location. Eustatic sea level has been determined from an analysis of worldwide tide gauges to have risen 18 cms (about 6 inches) in the past 100 years. This rise has been caused largely by the melting of land-based ice and the steric expansion of near-surface ocean water due to global warming.

Land surface changes are caused by crustal, seismic, and compaction subsidence. Crustal subsidence or uplift of the land surface is due to large-scale movement of the earth's crust (termed neotectonics). Seismic subsidence is episodic and caused by the sudden and irregular incidence of earthquakes. The Pacific states are most subject to this type of occurrence.

Compaction of underlying sediments can also result in land surface drop. Deltas (e.g., Mississippi delta) naturally subside, but this subsidence can be greatly accelerated by the withdrawal of subsurface fluids, namely groundwater, oil, and gas. The Louisiana tide gauges show the highest rates of relative sea-level rise in the United States, largely because of human-induced subsidence. Nondetaic areas can also subside as clearly shown by the Galveston, Texas tide gauge record.

Oceanographic factors, such as El Nino, can also have short-to medium-term effects on local sea level. Therefore, relative sea level (RSL) change at any location can be expressed as follows: RSL = E + L + O

where E = eustatic (or worldwide) change in sea-level
L = local change in land elevation
O = local change in ocean elevation due to ocean circulation change.

Of the identified causes of sea-level rise, only the eustatic rise is a universal, global effect (by definition). For any one area the other causes come into play in various proportions.

COASTAL IMPACTS

Rising sea-levels and growing coastal populations are already placing increasing strains on the coastal zones of the world. (Figure 1). The greenhouse effect has the potential to significantly increase eustatic sea-level rise, much above historical rates with dire consequences for society and coastal ecosystems.

The most recent and authoritative estimates of future sea-level rise are by the International Panel of Climate Change. It is estimated that by the year 2100 the eustatic rise will range between 0.31 m and 1.10 m, with 0.66 m (about 2 feet) being most likely (Figure 2). For planning and engineering purposes, coastal zone managers and decision-makers should utilize the one meter benchmark because this estimate is well within the probable range of change. Until climatologists can narrow down their range of temperature increase, sea-level rise scenarios must be used in designing coastal structures and forecasting beach erosion and flooding. Most countries, including the Netherlands, are using the one meter scenario for planning purposes. The principal effects of sea-level rise are increased flooding and wave-induced erosion.

COASTAL FLOODING

A rise in sea level represents a raising of water base level. Therefore, storm waves and surges can reach higher and further inland. This means that major flooding will occur more often. For example, "100-year" storms can occur in the future on a 15–20 year averaged basis by virtue of higher base levels when considering frequency-magnitude relationships of coastal flooding.

COASTAL EROSION

Sea level is one of the principal determinants of shoreline position. There are several reasons why sea-level rise would induce beach erosion or accelerate on-going shore retreat: (1) waves can get closer to shore before dissipating their energy by breaking, (2) deeper water decreases wave refraction and thus increases the capacity for longshore sediment transport, and (3) with a higher water level, the wave and current erosion processes are acting further up the beach profile, causing a readjustment of that profile. Maintenance of an equilibrium profile with sea-level rise requires an upward and shoreward displacement of the shoreline, which results in coastal erosion. For sandy beaches, at least a doubling and perhaps a five-fold increase in erosion rates can be forecast, depending upon the realized rates of accelerated sea-level rise.

CONCLUSIONS

Contemporary coastal land loss and human adjustments to only a small rise in sea level (approximately 1 foot) demonstrate the future calamity for erodible and low-lying coastal areas in response to accelerated sea-level rise. The continued rapid urbanization of coastal areas is also a national trend and worldwide phenomenon. There is the desire to build resort areas and retirement houses right at the sea's edge in order to enjoy the aesthetics and recreational attributes of the coast. The result is that a dominant and growing proportion of the nation's population, facilities and development are located on coasts in sensitive balance with local sea levels. Even the lower estimates of accelerated sea-level rise will place many areas in jeopardy during the coming decades. The low-lying coastal fringe is also subject to catastrophic events of flooding, particularly during hurricanes. The intensity of these large tropical storms is also likely to increase in the future due to global warming. Therefore, catastrophes will become a more frequent occurrence in the future as sea levels rise and coastal populations and infrastructure continue to increase.

WRITTEN TESTIMONY BY PETER C. PATTON, PROFESSOR, DEPARTMENT OF EARTH AND ENVIRONMENT SCIENCES, WESLEYAN UNIVERSITY, MIDDLETOWN, CT

SEA LEVEL RISE IN SOUTHERN NEW ENGLAND, A GEOLOGICAL PERSPECTIVE

Geological Record of Sea Level Rise

At the maximum extent of the last continental glaciation, about 22,000 years ago, sea level was approximately 100 meters lower than it is today. Most, if not all of the continental shelf along the east coast of the United States, south of the glacial margin, was exposed coastal plain (Bloom, 1983). Since that time, sea level has increased, flooded the continental shelf and established the modern position of the shoreline. Although the rate of sea level rise has varied over this time interval, there is no evidence of a major stillstand and sea level continues to rise today.

From a geological perspective, this rise in sea level is a natural consequence of an interglacial climate. During past interglacial periods sea level reached higher levels than that of the present. Two very obvious conclusions can be drawn from this history. First, sea level rise is a long-term geological phenomena and the present rise in sea level will continue into the foreseeable future. Second, sea level rise, while measured in millimeters per year, is perhaps the single most important geologic factor in shaping the shoreline and nearshore coastal environments of southern New England.

Sea Level Rise on the Connecticut Coast

Sea level rose into the Long Island Sound basin approximately 15,000 years ago (Lewis and Stone, 1991, Patton and others, 1993). The most detailed record of sea level change on the shoreline of Long Island Sound comes from analysis of coastal marshes which record sea level rise over the past 7,000 years (Bloom and Stuiver, 1963; Van de Plassche, and others, 1989; Patton and Horne, 1991; Thomas and Varekamp, 1991; Varekamp and others, 1992). This record is significant not only because it documents the magnitude of past fluctuations in the rate of sea level rise, but because it can be coupled with studies of coastal environmental change (Patton and Horne, 1992). This history can provide insight into the environmental consequences of future coastal submergence.

Figure 1 is the submergence curve for the Connecticut River estuary. The curve illustrates the relative position of sea level for the past 4,000 years. The position of the shoreline at any instant in time is a function of the volume of water in the ocean and the elevation of the land surface. Since both can vary, curves, such as the one shown in this figure, do not reflect absolute sea level, but rather the relative sea level for a particular area.

The reconstruction of past relative sea level at the mouth of the Connecticut River is based on the analysis of sediment cores drilled into the marshes that flank the modern estuary. At the bottom of some of these cores are deposits that represent the soils that formed on upland surfaces when sea level was lower and that are now buried by estuarine mud. The organic litter associated with these soils can be radiocarbon dated to determine a limiting age for coastal submergence. There is also one locality in the estuary where the stumps of black gum trees, still in growth position, can be found exposed at low tide. These trees typically grow at the upper tidal limit in freshwater floodplain forests. The radiocarbon age of these trees is also a limit to the submergence curve for the estuary.

The position of relative sea level is determined by radiocarbon age dating of peat deposits found in the cores, specifically, the remains of saltwater cordgrass (Spariina alterniilora), which grows in the intertidal zone. The first occurrence of these grasses in the cores marks the establishment of the modern marshes and also the position of the intertidal zone.

Age control is critical for the construction of these curves and the radiocarbon method does not provide accurate ages for the past 300 years. One additional point on the submergence curve was determined by analysis of pollen that accumulated in the marsh deposits. The pollen record is useful in fixing the period of colonization and land clearing in southern New England based on the increase in ragweed pollen (Ambrosia). Ragweed is an opportunistic invader species that quickly colonizes open fields, and it becomes a much larger percentage of the pollen rain in New England at the onset of agricultural land use.

The submergence curve of the estuary has two inflection points that separate the record into three time periods. Between 4,000 and 1,700 years ago, sea level rose at an average rate of 1.9 mm/yr. During this time interval sea level flooded into the Connecticut River estuary and drowned the low floodplain surfaces adjacent to the channel of the river. In one sense, this time interval represents the creation of the modern dimensions of the estuary.

After 1,700 years ago and perhaps until about 350 years ago, sea level rose at a rate of only 0.9 mm/yr. This low rate of submergence allowed the establishment of the modern marshes and many of the open water environments created in the previous phase of coastal flooding were converted to marshes, for example, modern Great Island at the mouth of the Connecticut River estuary.

The most recent limb of the submergence curve indicates that since the settlement of Connecticut, about 350 years ago, sea level has risen at about 2.2 mm/yr. or about 2.5 feet. It is worth noting that this is the highest rate of coastal submergence in the past 4,000 years. The historic rate of sea level rise measured from the sediment cores is essentially the same rate determined from the tide gauge at New London, CT for the period 1940–1971 (Gordon, 1980).

For the Connecticut River submergence curve, the points of inflection that separate times of more rapid sea level rise from periods of more slow rise are defined by single data points. This can result in error in determining when these changes actually occurred. Varekamp and others (1992) have attempted to create a high resolution sea level curve for the marshes along the Hammock River in Clinton, CT. Their results suggest sea level rise over the past 1,500 years has proceeded in a step-like fashion with low rates of sea level rise during climate intervals that are cold, such as the Little Ice Age (AD 1400–1700) and rapid during warm intervals, such as the Little Climate Optimum (AD 1000–1300). If correct, these results indicate that changes in the rate of sea level rise can occur quickly as global climate changes.

IMPACT OF FUTURE SEA LEVEL RISE IN LONE ISLAND SOUND

Impact on Coastal Zone Environments

The highiy variable topography of the coastal zone of southern New England makes the evaluation of future effects of sea level rise difficult. For example, bedrock coastal headlands and cliffs are resistant to erosion and sea level rise will have little impact on these coastal landforms.

Other coastal landforms are more vulnerable to rapid changes in sea level. Many of the sandy stretches of the Connecticut shoreline consist of barrier beaches. Landward of these beaches are broad salt marshes, connected to Long Island Sound by tidal creeks. Still farther landward theses marshes abut the upland surface. This landform assemblage occurs at all scales along the shoreline, Hammonassert Beach is one example (Patton and Kent, 1992).

The marshes behind the barrier beaches are maintained by the accumulation of sediment that is deposited on their surface through tidal flooding. The amount of sediment accumulation each year must balance the increase in relative sea level. Should sea level begin to rise at a rate in excess of the rate of sediment deposition, the marshes will drown and these back barrier habitats will be converted to shallow lagoons. In the most drastic scenario, the shoreline might be pushed to the upland boundary with the complete loss of this coastal habitaL

A similar scenario is plausible for the marsh systems that flank the modern estuaries and coastal coves. These marshes have only been established in the last 2,000 years and represent a very delicate balance between sea level rise and sediment accumulation rate. Should submergence proceed at a rate that is in excess of the sedimentation rate, there could be drastic loss of both salt and freshwater tidal marsh habitat. A similar loss of marsh habitat has been suggested for the coastal plain of New Jersey.

Tidal marsh systems are also at risk because of the development of the upland landscape. With rise in sea level marshes migrate over the adjacent upland surface. If this upland surface has been protected against sea level rise through the construction of sea walls, the marshes will not be able to migrate landward and will eventually drown (Titus and others, 1991).

Sea Level Rise and Flood Potential

One obvious affect of a rise in sea level is that the landward extent of coastal flooding during severe coastal storms will expand. The amount of landward shift of the flood zone will, of course, depend on the topography, and low relief coastal regions are the most at risk. Nevertheless, the increased flood potential will be realized to some degree along the entire coastline. In this regard, it is sobering to realize that at the European settlement of Connecticut there was about 2.5 feet more freeboard on the shoreline.

A major infrastructure problem in the coastal zone are storm-water drainage systems that were constructed when sea level was lower. As sea level rises, the capacity of these systems decreases. This problem is aggravated during coastal storms

when storm surges in Long Island Sound create abnormally high tides and rainfall from these same storms produce large discharges from the upland drainage basins.

Finally, the large rivers in the State are tidal and will be affected by the rise in sea level. In my opinion, the greatest problem will be the increased frequency of damaging floods on these rivers. The Connecticut River at Middletown, CT is a good example.

The Connecticut River is tidal to the Massachusetts border. Presently, the 100-year flood at Middletown, the flood with a 1 percent chance of occurrence each year, has a discharge of 235,000 ft^3/s and reaches an elevation of 25.5 feet above sea level. As sea level rises, so does the base elevation for these flood events. Thus a one-foot rise in sea level will cause the current 100-year flood level to be reached by a lesser flood event. If, in the next century, sea level rises 3 feet (a not unlikely scenario, see for example: National Academy Press, 1987; Titus and others, 1991), the current 100-year flood level will be reached by a flood with a magnitude of about 200,000 ft^3/s, which is equivalent to the modern 50-year flood, or the flood with a 2 percent chance of occurrence each year. Therefore, sea level rise will have doubled the risk for flooding on the floodplain along the Connecticut River. Given that floodplain development has crowded up against our current flood encroachment lines, this increase in base elevation of our tidal rivers could have disastrous consequences.

Planning for Sea Level Rise

Planning for sea level rise will require a far-sighted effort. On an annual basis, the effects of millimeter scale changes in sea level may appear trivial to some, and this attitude may discourage government from acting. However, the inexorable rise in sea level will cause profound changes to our shoreline on the time scale of a few generations. We must utilize our knowledge of the geologic record to remind us that the present configuration of the coastal zone is merely a snapshot of a landscape in continuous evolution. By acting now we can insure that rich ecological habitats will continue to flourish as they migrate landward and that the risks to our use of the coastal zone will be minimized.

References Cited

Bloom, A.L., and Stuiver, M., 1963, Submergence of the Connecticut Coast: Science, v. 139, p. 332–334.

Bloom, A.L., 1983, Sea level and coastal morphology through the Late Wisconsin Glacial Maximum: in S. Porter, ed., Late Quaternary Environments of the United States, v. 1, The Late Pleistocene, University of Minnesota Press, p. 215–229.

Gordon, R.B., 1980, The sedimentary system of Long Island Sound: in B. Saltzman, ed., Studies in Long Island Sound, Advances in Geophysics v. 22, p. 1–35.

National Academy Press, 1987, Responding to changes in sea level: Washington, DC, p. 148.

Patton, P.C. and Horne, G.S., 1991, A submergence curve for the Connecticut River estuary: Journal of Coastal Research, v. 11, p. 181–196.

Patton, P.C. and Kent, J.M., 1992, A Moveable Shore: The fate of the Connecticut coast: Duke University Press, Durham, NC, p. 143.

Patton, P.C., 1992, Response of the Connecticut River to late Holocene sea level rise: Geomorphology, v. 5, p. 391–417.

Patton, P.C., Horne, G.S., Lewis, R.S., and Arnold, C.L., 1993, Late Quaternary evolution of the estuarine environments on the Connecticut shore of Long Island Sound: Geological Society of America, Abstracts with Programs, v. 25, n. 6, p. 334–335.

Redfield, A.C., and Rubin, M., 1962, The age of salt marsh peat and its relation to recent changes in sea level at Barnstable, MA: Proc. National Academy of Science, v. 48, p. 1728–1735.

Titus, J.G., Park, R.A., Leatherman, S.P., Weggel, J.R., Greene, M.S., Mausel, P.W., Brown, S., Gaunt, C., Trehan, M., and Yohe, G., 1991, Greenhouse effect and sea level rise: potential loss of land and the cost of holding back the sea: Coastal Management.

Thomas, E., and Varekamp, J.C., 1991, Paleo-environmentai analyses of marsh sequences (Clinton, CT): evidence for punctuated rise in relative sea level during the latest Holocene: Journal of Coastal Research, v. 11, p. 125–158.

Van de Plassche, O, Mook, W.G., and Bloom, A.L., 1989, Submergence of coastal Connecticut 6000–3000 years: Marine Geology, v. 86, p. 349–354.

Varekamp, J.C., Thomas, E., and Van de Plassche, O., 1992, Relative sea level rise and climate change over the last 1500 years: Terra Nova, v. 4, p. 293–304.

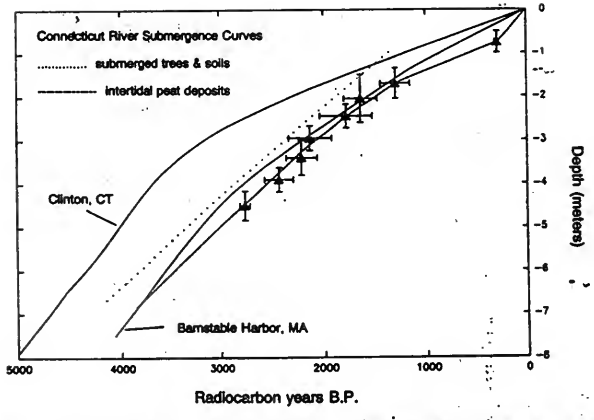


Fig. 1. Submergence curve for the Connecticut River estuary. The triangles mark the position of dated intertidal peat deposits. Horizontal error bars represent the standard error of radiocarbon ages. The upper triangle represents peat deposits age dated by pollen stratigraphy and the error bars represent the estimated error in determining this historic horizon. The dotted curve represents the position of dated submerged soil horizons and in situ tree stumps which determine an upper limit for the submergence curve of the estuary. For comparison, submergence curves for Clinton, Connecticut (Van de Plassche et al., 1989) and Barnstable Harbor, Massachusetts (Redfield and Rubin, 1962) are included.

PREPARED STATEMENT OF FRANKLIN W. NUTTER, PRESIDENT, REINSURANCE ASSOCIATION OF AMERICA

Mr. Chairman, members of the Committee, I am Franklin W. Nutter, president of the Reinsurance Association of America. The Association represents U.S. domestic professional reinsurance companies that together write property/casualty reinsurance coverage in all 50 States. We are pleased to have this opportunity to discuss the impact on the insurance industry of potential climate changes and comment on the Administration's Climate Change Action Plans.

At the outset I would like to give credit for research provided by the Property Claims Services, an adjunct of the American Insurance Services Group, and Swiss Reinsurance, headquartered in Zurich, Switzerland, which conducts research on natural catastrophes affecting the insurance industry worldwide. Their data provide extraordinary insights into the effect of natural catastrophes on the United States.

FREQUENCY OF NATURAL CATASTROPHES

While the number of natural catastrophes worldwide has increased rather dramatically in recent years, in the last 20 years the United States has experienced little change on a year-to-year basis in the number of such catastrophes. Using their criteria, Swiss Re reports that in the period 1970 to 1981, there were 132 catastrophes worldwide, and in the period 1982 to 1992, 226 such catastrophes—an increase of 94 percent over the prior 10 year-period. With regard to the United States, however, the number of catastrophe[1] reported were as follows:

1949–1959	1960–1969	1970–1979	1980–1989	1990–1993
88	159	327	313	124

Thus, what we see is that the occurrence of natural catastrophes has been rather stable in the United States in the last 20 years, although there was a fairly significant increase from the preceding 20-year period. Natural catastrophes in this context include hurricanes, earthquakes, wild fires and, in a few cases, man-made occurrences (e.g., petro-chemical explosion).

SEVERITY OF CATASTROPHES

While the frequency of natural catastrophes may be startling to some, it is the magnitude of these catastrophes in the United States and the size of the insured loss that is far more notable. Prior to mid-1988, the insurance industry worldwide had never experienced insured losses from a single event which exceeded $1 billion. Since mid-1988, the industry worldwide has experienced 14 such events. The Property Claims Services report that of the 20 largest insured catastrophes in the United States, 16 have occurred since 1989; 12 of those 20 involved a combination of wind (hurricane) and water (flooding). Exhibit 1 lists each of those natural catastrophes together with their dates, states affected and the insured loss.

Looking at the U.S. insurance industry's historical catastrophe losses from 1949 to 1993, as set forth in Exhibit 2, one can see that the number of natural catastrophes has increased since the 1940's and 1950's but has remained relatively stable in the 1970's, 1980's and 1990's. The insured loss, however, has risen dramatically, peaking in 1992 at nearly $23 billion in claim payments as a direct result of natural catastrophes alone. Over more than four decades, 45 percent of all catastrophe related insured claims have been paid since 1990.

TRENDS AFFECTING INSURED LOSES

In recent years, scientists and researchers outside our industry have dramatically improved their ability to monitor changes in climate and have advanced various theories for these changes, including global warming, El Nino, changes in dry and rainy seasons in West Africa, volcanic activity, and acid rain. While our industry is deeply interested in this scientific research, it has to date focused on the economic and demographic forces driving up insured losses and premiums. In this context, it is clear that two significant trends have deeply affected the insurance industry's loss experience due to weather conditions.

The first of these trends is growth in insured exposures as a result of population shifts. Census data shows that 50 percent of U.S. mainland population lives within 50 miles of a coast; 44 percent of our population lives in coastal counties where the population density is four times the national average. By the year 2010, the U.S.

[1]The number of U.S. catastrophes is based on the criteria of the Property Claim Services.

coastal population is estimated to be 127 million people. This is based on analyses which suggest that of the 20 states that can expect to experience growth by the year 2010, 17 are coastal states. As is noted in "Preparing for an Uncertain Climate," this trend includes significant development on barrier islands, as our population has been attracted to coastal waterways and shorelines. This shift in our population to high risk coastal areas is exacerbated by the ballooning effect that tourism and vacation homes have on the population exposed to coastal natural catastrophes such as hurricanes, flooding, and windstorms. It is reported that it is not uncommon for popular coastal communities to increase their "population" by a factor of 10 during warm weather seasons, including seasons during which hurricane activity is most prominent: late summer and early fall. With these population shifts come higher exposure to loss of life and property to both sudden and gradual forces of nature.

The second major trend affecting the insurance industry is growth in exposure due to increases in insured values in high risk areas. Estimates are that the insurance industry's total exposure in coastal communities in 1992 is slightly in excess of $2 trillion in insured value, an increase from $1.13 trillion in 1980. The loss potential due to natural weather forces is extraordinary.

PROBABLE MAXIMUM LOSS

Our industry has had the benefit in recent years of dramatic improvements in its ability to assess its exposure to natural catastrophes, both earthquake and hurricane, through computer models, using historical experience to calculate storm and seismic probability and loss potential. The potential insured losses from these events is staggering. Exhibit 3 reflects estimates of insured losses, including property, business interruption, workers compensation and other commercial losses as a result of various hurricane or earthquake scenarios. It shows that a class 5 hurricane striking New Orleans would be estimated at $25.6 billion in insured loss; Galveston, TX—$42.5 billion; Miami—$53 billion; Hampton, VA—$33.5 billion; Asbury Park, NJ—including coastal areas from Delaware to Connecticut—$52 billion (class 4 hurricane); New York City—$45 billion (class 4 hurricane).

A risk profile of the United States setting forth potential exposure to floods reflects equally dramatic exposure. It is important, however, to recognize that much of that exposure is insured by the National Flood Insurance Program, underwritten by the United States Government and not by the private insurance sector. Private insurers do insure flood risk in commercial policies, however. For example, the private sector had insured damages in the June–July 1993 Mid-west floods of approximately $745 million, although total damage was estimated at $10.5 billion.

TODAY'S LOSSES FROM PAST DISASTERS

It is revealing to examine potential future losses, but it is perhaps more reflective to retrace our steps and examine past actual events and update them to current dollars and the current size of the insured market. Exhibit 4 lists hurricane events in the United States from 1949 to 1992, reflecting the original loss paid updated to 1992 dollars and 1992 insured markets. You see from this exhibit that the loss in these hurricanes would rise dramatically should there be a recurrence of the same natural events that have previously taken place. A similar analysis of storms in the United States, including floods from 1950 to 1993, reflects tremendous increases in probable losses associated with previously encountered actual events. For example, in 1950 a storm that affected 14 states caused insured damages of $174 million. Tracking the storm through those same states using today's insured values, the losses in 1992 dollars would be $6.6 billion.

INSURANCE INDUSTRY REACTIONS

Recent natural catastrophes, particularly Hurricane Andrew in August 1992 and the Northridge Earthquake of January 1994, have energized our industry to address the potential effects of natural catastrophes and changing weather patterns. In January 1994 the industry created the Insurance Institute for Property Loss Reduction, committed to study coastal building codes and their enforcement and develop an evaluation grading system for those codes that, like fire codes and departments, will be used as part of the industry's rating system. The Institute will also develop a wind damage evaluation system for commercial structures and begin research on building materials, methods and techniques to assist the construction industry in supplying homes and business that are more highly resistant to wind and water damage from natural events.

Many companies in our industry are also re-evaluating their contract coverage, the expansion of which has been a contributing factor to the increased insured losses sustained in recent years. Thus, companies are evaluating the size of

deductibles in insurance contracts, the potential value to insureds and insurers in creating deductibles solely associated with hurricanes, guaranteed replacement cost coverages and coverage for additional living expense. The examination of these coverages is designed to help insureds with the probable increase in the cost of homeowners and commercial coverages necessitated by the extraordinary increases in loss experience. Based upon management's analysis and, in some cases, regulatory scrutiny, some companies in our industry are evaluating their commitment to insure in high-risk coastal areas at current market conditions. Naturally, this has created some tension between insurers, insurance agents and regulatory officials as they strive to maintain insurance markets without threatening the solvency of the insurers themselves.

Our industry has also supported the Natural Disaster Protection Act, a bill sponsored by Senator Daniel Inouye, and cosponsored by a bipartisan group of 16 other Senators. This legislation directly addresses natural catastrophes by creating a program of hazard mitigation and loss reduction, together with an insurance and reinsurance program offered by the Federal government to provide insurance markets for earthquake coverages and a financial safety net for the industry in the event of a truly catastrophic natural catastrophe. The Committee is directed to a hearing to be held on April 27 by the Senate Commerce Committee on this legislation at which time the insurance aspects of the program are to be examined.

CONCLUSION

In conclusion, the insurance industry stands next in line after the immediate victims of natural catastrophes. As a result, our industry is becoming increasingly aware that changes in our climate are affecting both the demand for property insurance and its financial health. I believe our industry can and should do more to understand climate change and what is driving it. Published research from the scientific community and weather data report cooling temperatures, extraordinary wet seasons in some parts of the world, prolonged dry spells in other parts of the world, and an increase in intensity of windstorms.

We are not scientists. However, our industry cannot ignore the dramatic increase in insured claims as a result of natural catastrophes, particularly hurricane, earthquake and flood. We must further recognize that this can only partially be explained by population shifts and increases in insured values. I commend this Committee and the Administration for its attention to climate change and commit our Association to working with the various interests in seeking a further and fuller understanding of the causes of climate change so that we can address those causes and the effects of climate on our society.

CATASTROPHE RECORD

CATASTROPHE RECORD TOP 20 LIST

CAT#	PERIOD	STATE(S)	PERILS	YEAR	ESTIMATED LOSS
27	AUG 24-26	FL,LA	HURRICANE ANDREW;WIND;TORNADOES;FLOODING	1992	15,500,000,000
78	JAN 17	CA	EARTHQUAKE;FIRE	1994	4,500,000,000
18	SEP 21-22	NC,GA,PR,VI,SC,VA	HURRICANE HUGO;WIND;TORNADOES;FLOODING	1989	4,195,000,000
46	MAR 11-14	MS,NC,AL,FL,GA,SC,MD,DE,PA,NY,RI,MA,VT,NH, TN,KY,OH,TX,LA,VA,NJ,CT,ME,WV	WIND;HAIL;TORNADOES;FREEZING;ICE;SNOW	1993	1,750,000,000
87	OCT 20-21	CA	FIRE	1991	1,700,000,000
30	SEP 11-12	HI	HURRICANE INIKI;WIND;FLOODING	1992	1,600,000,000
20	OCT 17	CA	EARTHQUAKE	1989	960,000,000
24	DEC 17-30	AL,AR,CO,CT,DE,FL,GA,ID,IL,IN,IA,KS,KY,LA,MD, MA,MI,MN,MS,MO,MT,NE,NJ,NY,NC,ND,OH,OR,RI, OK,PA,SC,SD,TN,UT,VA,WA	WIND;SNOW;FREEZING	1983	880,000,000
14	APR 29/MAY 4	CA	RIOT;CIVIL DISORDER	1992	775,000,000
13	APR 28-29	TX,OK	WIND;HAIL;TORNADOES	1992	760,000,000
27	SEP 12-14	AL,FL,KY,LA,MS,NY,OH,PA,TN,WV	HURRICANE FREDERIC;WIND	1979	752,510,000*
--	JUNE - JULY	MN,IA,WI,IL,MO,KY,AR,LA	FLOODING	1993	745,000,000
15	AUG 16-20	TX	HURRICANE ALICIA;WIND	1983	675,520,000
39	DEC 10-13	WV,VA,MD,DE,PA,NJ,NY,CT,RI,MA	WIND;FLOODING;SNOW	1992	650,000,000
45	JUL 11	CO	WIND;HAIL;TORNADOES	1990	625,000,000
85	AUG 18-20	CT,MA,RI,NC,NY,ME	HURRICANE BOB;WIND;TORNADOES;FLOODING	1991	620,000,000
97	MAR 24-25	TX,LA,FL	WIND;HAIL;TORNADOES;FLOODING	1992	610,000,000
19	JUN 19-20	KS,OK	WIND;HAIL;TORNADOES	1992	570,000,000
79	JAN 17-20	IL,IN,OH,KY,TN,NC,SC,PA,WV,VA,MD,DE,NJ,NY, CT,RI,MA,ME,VT,NH	WIND;SNOW;ICE;FREEZING	1994	550,000,000
81	AUG 30/SEP 3	AL,FL,LA,MS	HURRICANE ELENA;WIND;TORNADOES;FLOODING	1985	543,000,000

SOURCE: PROPERTY CLAIM SERVICES

EXHIBIT #1

FWN/pac CAT.REC

CATASTROPHE LOSSES, 1949-93

	# OF CATS	($, Millions.)
1949	4	22.3
1950	9	222.3
1951	4	16.5
1952	6	17.8
1953	15	87.7
1954	10	293.4
1955	9	91.4
1956	8	56.8
1957	11	73.6
1958	6	20.5
1959	6	47.2
1960	9	130.0
1961	13	169.3
1962	17	192.3
1963	8	32.7
1964	19	225.2
1965	12	851.4
1966	15	106.8
1967	28	185.0
1968	19	127.1
1969	19	253.2
1970	18	413.3
1971	32	128.6
1972	30	211.3
1973	36	358.6
1974	26	656.5
1975	31	501.6
1976	27	273.1
1977	40	366.2
1978	41	652.8
1979	54	1,684.6
1980	51	1,177.0
1981	33	714.2
1982	33	1,528.4
1983	33	2,254.8
1984	26	1,548.3
1985	34	2,783.3
1986	26	871.5
1987	24	946.0
1988	32	1,409.0
1989	34	7,642.0
1990	32	2,825.0
1991	36	4,223.0
1992	36	22,970.0
1993	36	5,620.0

Source: Property Claims Service Div., American Insurance Services Group Inc.; A.M. Best Co.

EXHIBIT #2

FWN/pac CATLOSS

PROBABLE COSTS OF FUTURE NATURAL DISASTERS

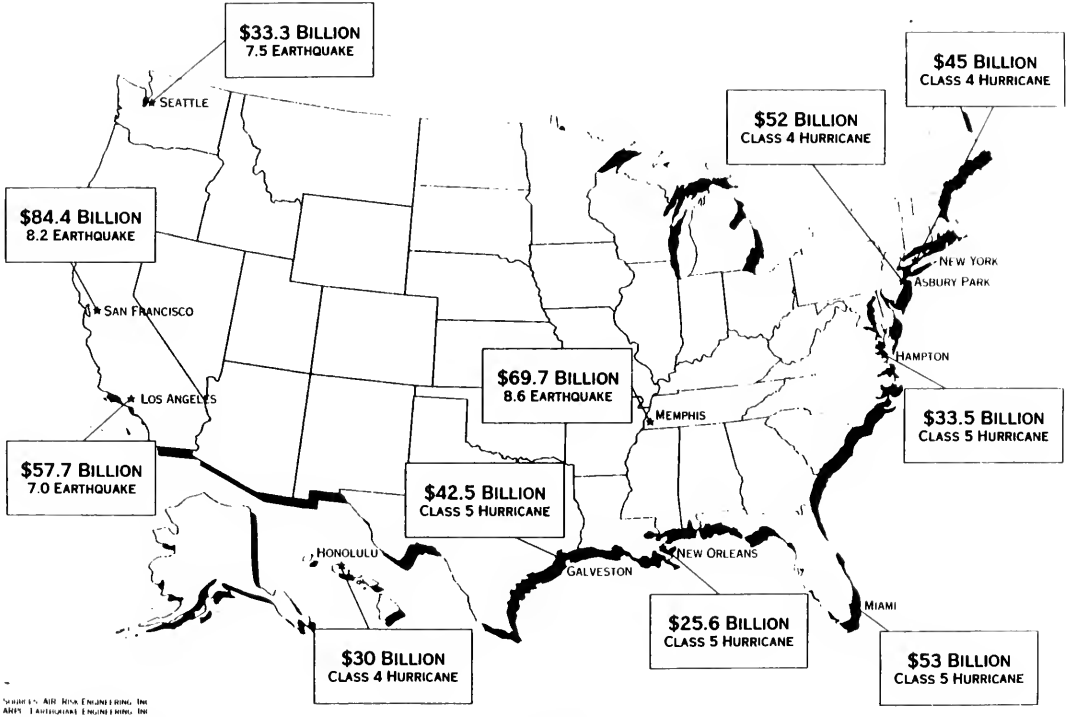


EXHIBIT #3

Most Costly Insured Hurricanes in the U.S.

Date	Most Costly Insured Hurricanes in the U.S. Event	Original $ Estimated Loss ($, Mil.)	92 Market 92 $, Mil
1992, Aug. 30	Hurricane Andrew - FL, LA	16,000.0	16,000.0
1965, Sept. 7-10	Hurricane Betsy - FL, AL, MS, LA	715.0	7,717.3
1989, Sept. 17-22	Hurricane Hugo - VI, PR, GA, SC, NC, VA	4,296.0	4,755.4
1954, Oct. 15-16	Hurricane Hazel - SC, NC, VA, WV, DC, MD, DE, NJ NY,PA	122.1	3,328.9
1954, Aug. 30-31	Hurricane Carol - NY, CT, RI, MA, ME, NH, NJ	129.7	2,934.6
1970, Aug. 3	Hurricane Celia - TX	310.0	1,962.5
1960, Sept. 9-11	Hurricane Donna - FL, MA, NJ, NY, NC, RI, VA	91.0	1,625.1
1992, Sept.	Hurricane Iniki - HI	1,600.0	1,600.0
1961, Sept. 9-12	Hurricane Carla - TX, LA	100.0	1,547.7
1979, Sept. 12-14	Hurricane Frederic - MS, AL, FL, LA, TN, KY, WV, OH PA,NY	752.5	1,480.1
1950, Oct. 17	Hurricane Unnamed - FL	10.5	1,318.5
1983, Aug. 17-20	Hurricane Alicia - TX	675.5	1,131.2
1949, Aug. 26	Hurricane unnamed - GL, GA, SC, NC	8.3	1,091.8
1964, Aug. 26	Hurricane Cleo - FL	87.2	1,026.4
1969, Aug. 17-18	Hurricane Camille - LA, MI, AL, FL, TX	225.0	991.0
1988, Sept. 10-17	Hurricane Gilbert - Dom Republic, Haiti, Jamaica Mexico, US	790.0	948.0
1985, Aug. 30-Sept. 3	Hurricane Elena - FL, AL, MS, LA	543.3	703.5
1955, Aug.11	Hurricane Connie - NC, PA, MD, NJ, NY	25.2	642.4
1991, Aug. 18-20	Hurricane Bob - NC, NY, RI, CT, MA	620.0	629.3
1957, June 27	Hurricane Audrey - TX, LA	32.2	608.8
1972, June 17-25	Hurricane Agnes - FL, GA, SC, NC, VA, WV, OH, MI, P MD, DE, DC, NJ, NY, CT, RI, MA, ME, VT	97.9	540.0
1985, Sept. 26-27	Hurricane Gloria - NC, VA, MD, DE, PA, NJ, NY, CT, RI MX, NH, VT, ME	418.7	515.9
1975, Sept. 16-28	Hurricane Eloise - FL, AL, GA, TN, WV, VA, MD, DE, DC PA, NJ, NY, MA, CT, R.I., P.R.	119.2	436.2
1954, Sept. 19	Hurricane Edna - CT, RI, MA, NH, ME	12.5	388.4
1967, Sept. 19	Hurricane Beulah - TX	34.0	319.8
1979, Aug. 30-Sept. 6	Hurricane David - FL, FA, SC, NC, VA, MD, DC, DE, PA NJ, NY, Ct, MA, P.R., V.I.	122.1	264.9

SOURCE: Property Claims Services (PCS) Division; American Insurance Services Group Inc ./ Lehman Brothers

EXHIBIT #4

Most Costly U.S. Storms, Tornadoes, Floods

Date	Most Costly U.S. Storms, Tornadoes, Floods Event	Original $ Estimated Loss ($, Mil.)	92 Market 92 $, Mil
1950, Nov. 24	Wind, rain, storm - 14 states	173.9	6,580.1
1993, Mar. 11-14	Freeze, snow, ice, hail, wind (Josh) - 20 states	1,625.0	1,625.0
1974, Apr. 2	Tornado, wind, hail -- 17 states	430.6	1,432.4
1983, Dec 17	Freeze, snow, wind - ALL BUT 9 STATES	880.0	1,231.9
1950, May 4	Hail, tornado, wind - IL,KS,MN,MO,NE	25.8	1,211.0
1962, Oct 11-13	Windstorm - N. Calif, OR, WA	81.0	1,093.5
1993, Jun. 16 - Jul. 16	Midwest floods	900.0	900.0
1992, Apr. 28-29	Wind, hail, tornadoes - TX,OK	760.0	760.0
1990, July 11	Wind, hail, tornadoes - CO	625.0	659.9
1992, Dec. 10-13	Wind, flood, snow (Beth) - 10 states	650.0	650.0
1992, Mar. 24-25	Wind, hail, tornadoes, flood - TX,LA,FL	610.0	610.0
1992, June 19-20	Wind, hail, tornadoes - KS, OK	570.0	570.0
1989, Dec. 21-26	Freeze,ice,snow - 21 states	500.0	549.2
1965, Apr. 11	Tornadoes, hail - OH,MI,IN,IL,WI	70.0	498.3
1985, Jan. 18	Freeze, snow, wind - 29 states	400.0	492.6
1979, Apr. 10	Flood, hail - AL,AR,GA,IL,IN,KS,LA,MS,MO,OK,TN,TX	239.9	489.3
1992, Nov. 21-23	Wind, hail, tornadoes, flood - 11 states	425.0	425.0
1990, Dec. 18-26	Wind, hail, tornadoes, freeze - 20 states	400.0	422.4
1989, May 3-6	Wind, hail, tornadoes, flood - IA,IN,OH,WV,NC,NE	380.0	421.5
1984, June 13	Flood, hail, tornado, wind - CO	276.7	406.8
1982, Apr. 2	Hail, Ice, Tornado - 24 states	243.5	406.1
1966, June 8	Tornadoes, wind - Northeast Kansas	57.0	403.5

SOURCE: Property Claims Services (PCS) Division; American Insurance Services Group Inc./Lehman Brothers

EXHIBIT #5

REINSURANCE ASSOCIATION OF AMERICA,
1301 Pennsylvania Avenue NW, Washington, DC,
May 6, 1994.

THE HONORABLE JOSEPH I. LIEBERMAN,
Chairman, Subcommittee on Clean Air and Nuclear Regulation,
United States Senate,
456 Senate Dirksen Office Building,
Washington, DC 20510–6175

Re: April 14, 1994 testimony on potential climate changes.

DEAR SENATOR LIEBERMAN. Thank you for your letter of April 25 enclosing questions for the record from Senators Lieberman and Chafee.

Enclosed are my responses as you requested.

Very truly yours,

FRANKLIN W. NUTTER,
President.

QUESTIONS FOR MR. NUTTER FROM SENATOR LIEBERMAN

1. You have testified that global change may be helping to cause an increase in natural disasters and have warned that insurance companies need to be alert to these possible changes.

What role can the insurance industry play in helping to avoid some of the consequences of global warming?

Is the insurance industry participating in efforts to aggressively implement the President's Plan?

Can the industry play a role in encouraging investments in, for example, energy efficiency and renewable technologies?.

2. If companies determine that some areas, such as southern Florida or the New Orleans and Galveston areas are very high risks in relation to sea level rise and increased coastal storms, can they simply abandon these markets? What would it take for this to happen? What recourse would be left to the homeowner or local businessman under such circumstances?

3. In your testimony you indicate that insured loss has risen dramatically in the past 50 years, peaking at nearly $23 billion in claim payments in 1992. This tremendous increase in loss has, as you pointed out been caused, in part, by the increased number of people living in the coastal zone. Based on the industry's actuarial analysis, do you foresee a trend of this magnitude continuing?

QUESTION FOR MR. NUTTER FROM SENATOR CHAFEE

Some believe that the recently documented changes in sea level are part of a natural ebb-and-flow. Presumably, insurers take into account such variations.

What additional, or crippling effect would additional increases in this ebb-and-flow have on insurers and their ability to plan for rating?

RESPONSES BY MR. NUTTER TO QUESTIONS FROM SENATORS LIEBERMAN AND CHAFEE

1. The insurance industry is sponsoring the Insurance Institute for Property Loss Reduction to evaluate community building codes and their enforcement. In addition, the Institute will be researching improved building construction, design and material improvements to reduce loss of property and life due to natural hazards.

To my knowledge, the industry is not yet participating in efforts to support the President's Climate Change Plan although I believe the industry and its policyholders have a vested interest in understanding the causes of climate change and advancing solutions which reduce the ultimate effect of natural hazards.

The insurance industry manages a large portfolio of investments and could be encouraged to invest at least a portion of these resources in technologies which improve energy efficiency and renewable resources.

2. State law varies regarding an insurer's intention to withdraw from certain markets. Regulators have a responsibility to see that an insurer is not threatened with financial impairment as a result of its underwriting decisions (including concentration of policies in high risk area) by evaluating whether it is sufficiently reinsured (which spreads this risk), capitalized, and uses adequate rates. On the other hand, one state (Florida) imposed a moratorium on non-renewals and cancellations after Hurricane Andrew (this moratorium was subsequently converted to an allowable 5 percent per year phase-out should a company desire). An insurer might want to withdraw from an insurance market if the threat of losses could impair its financial

viability. States do maintain mandatory risk pools for high risk insureds unable to find coverage in the private market. This has the effect of requiring licensed insurers to provide "involuntary" insurance markets.

3. Federal reports indicate continuing increases in populations and insured values in high risk coastal areas. Meteorologists predict near term periods of increased storm (particularly hurricane) activity, including frequency and severity. The confluence of these trends makes increased losses inevitable.

4. Insurance premiums reflect actuarial analysis—customarily based on historical data. To the extent historical data does not reflect future weather patterns, the actuarial analysis would be compromised. In recent years, insurers have begun using modeling techniques which take into consideration probable future weather effects, insured values and locations.

PREPARED STATEMENT OF MICHAEL D. BOWES, SENIOR ANALYST, ENVIRONMENT PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT

DEAR MR. CHAIRMAN. Thank you for the opportunity to share with you some of the findings of OTA's recent assessment, Preparing for an Uncertain Climate. This is OTA's second report on climate change. In 1991, we published Changing by Degrees: Steps to Reduce Greenhouse Gases, which focused on ways to reduce the buildup of greenhouse gases in the atmosphere. Many scientists believe that the buildup of greenhouse gases will cause the Earth's climate to warm significantly over the next century. As a result of this warming, it is expected that there will be rising sea levels and perhaps changes in the frequency of damaging storms. Concerns about such climate changes have led over 160 countries to sign a world climate treaty, agreeing to take steps toward stabilizing their emissions of greenhouse gases, including carbon dioxide and methane. The Climate Action Plan released by the White House on October 19, 1993, describes steps that the United States is taking toward limiting its growth in emissions.

Despite such landmark international efforts, the bulk of scientific evidence indicates that simply freezing emissions at current levels will not stop global warming. There would still be gradual increases in atmospheric concentrations of greenhouse gases and, thus, an increase the heat-trapping capacity of the atmosphere. Further, given the virtual certainty that energy use (and CO_22 emissions) in developing countries will rise as they pursue economic growth, and given the intense debate in the industrialized countries about the potential economic costs of an emissions freeze, it seems likely that worldwide emissions of greenhouse gases will, in fact, continue to rise. Thus, unless the predictive climate models are seriously flawed, average global temperatures are expected to increase.

If some climate change is inevitable, then so is the need to adapt. Society and nature may have to cope with rising seas, more frequent droughts and heat waves, changes in water supplies, threats to the health of our forests and ecosystems, and changes in the productivity of agricultural lands. Sea level rise, for example, could lead to higher storm surges and increased erosion of coasts; the loss of coastal wetlands may be accelerated. Climate changes may gradually threaten the habitat of endangered species, adding to the costs of protection and increasing conflicts over land use and the Endangered Species Act.

Unfortunately, some of the key information that might guide any policy or management response to these potential impacts is likely to remain unknown for some decades. Although understanding of climate change has progressed, major uncertainties remain. For example, it is beyond current scientific capabilities to predict the timing or magnitude of climate change at the local scale. Predicting changes in climate variability and weather extremes, particularly at small spatial scales, is also beyond current capability. We are also limited in our understanding of the ecological or economic impacts of climate changes and the ability to adapt. The U.S. Global Change Research Program has been overwhelming a physical science program, and has not addressed the natural resource management or ecological science questions that might give practical guidance for adaptation. Given the inability to predict accurately where, when, and how much change will occur, policy decisions made in the near future about how to respond to the threat of climate change must be made in light of considerable uncertainty.

OTA was asked by Congress to think about coping with these uncertainties. Specifically OTA was asked: "Given the uncertainty about future climate, are there any useful actions that can be taken now?" The assessment examines six natural-resource systems: the coastal zone, water resources, agriculture, forests, wetlands, and preserves (e.g., parks and wildlife reserves). OTA focused its examination on natural resources because: (1) some potential impacts of climate change may be costly or ir-

reversible; (2) the validity of long-term decisions made today may be later affected by climate change; (3) better preparation for current climate variability and extremes is already warranted; and (4) there is a significant Federal role in research, planning, or management. We have looked at the ability of the six systems to adapt to climate change and consider means by which adaptation can be enhanced by public policy or management.

OTA identifies more than 100 specific policy options that would help the United States position itself to better cope with any potential climate change. These options are based on input from over 300 researchers and resource managers who were heard over the course of several workshops, through contract papers, or as reviewers. Some of these options have been flagged as first steps—options that make sense to address promptly. Some need to be addressed because they address "front-line" issues that will need attention before informed policy can be made. Others are sensibly addressed now because they provide immediate benefits or because near-term legislative actions will provide a target of opportunity to pursue the option. A brief summary of each chapter and its policy options is provided at the end of this testimony.

OTA argues that the uncertainty of climate change does not mean that the Nation cannot position itself better to cope with a range of possible impacts. There are opportunities to avoid adverse impacts by acting now. In fact, delay in responding may in some cases leave the Nation poorly prepared to deal with whatever changes do occur. Federal agencies are currently making many decisions about the management of natural resources, the validity of which could be affected by climate change. What the Government decides now, if not well considered, could limit or foreclose the ability to adapt to future climate change.

Given the uncertainty, two general characteristics of useful adaptation policies stand out. First, there are those that can be described as improving flexibility—helping to improve ability to adapt to any change in circumstances. Second are those that provide robustness—reducing vulnerability to climate variations in general, or protecting against some particular negative consequence of future climate extremes.

Congress can enhance the flexibility of the various resource systems through actions that fall broadly into three categories: (1) learn more about the natural resource system and its climate sensitivity, (2) improve the technology and know-how required for adaptation, and (3) remove institutional impediments that inhibit the ability or incentive to respond to climate risks. The last category is of particular relevance in the coastal zone, where subsidized flood insurance encourages a degree of development in high-risk zones, development that may prove unwise if sea levels rise. Options that enhance the robustness of systems also fall broadly into three categories: (1) reduce existing threats to natural resources and ecosystem health; (2) improve contingency planning and preparedness for existing climate extremes, (3) learn how to restore declining ecosystems.

Among the policy options are several that address existing problems and inefficiencies as well as help against the uncertainties posed by climate change. Many studies term such options no regrets or low regrets. The potential for added benefits under climate change simply strengthens the case for action. At the other extreme, we identify some options that would prove most useful only in the event of severe climate change. The costs of such activities may be considered in the same light in which insurance is purchased—a small premium now may help insure against the threat of costly future ecological or economic damage. Just how much effort should be expended to avoid such future risks must ultimately depend on balancing current costs against the likelihood and scale of future damages avoided.

FIRST STEPS—TARGETS OF OPPORTUNITY

In each resource chapter of the OTA report Preparing for an Uncertain Climate, logical "first steps" are outlined to illustrate ways to begin incorporating climate change considerations into statutes, policies, and programs relating to natural resources. Regular congressional reauthorization cycles, the annual budget cycle, elections, the division of responsibilities among congressional committees, and still other policy-making realities provide the context in which decisions about climate change will actually be made. Seen in this light, the choice of first steps is significantly influenced by an assessment of where the opportunities lie. Several targets of opportunity in the near-term congressional agenda, in the initiatives of the new Administration, and in the programs of the various agencies can be capitalized upon now.

Annual Appropriations

Even if Congress did nothing else, each year it would enact legislation appropriating money for carrying out governmental programs. Thus, an immediate opportunity

to address many of the issues considered in OTA's report is through the appropriation process. Most simply and directly, Congress can ensure adequate levels of funding for existing climate-change-related research programs. Through the appropriation process, Congress can also encourage natural resource management agencies to carry out their monitoring and research programs in ways that meet current objectives while simultaneously producing data that would be useful for climate change research efforts.

The annual appropriation process is also the means by which Congress makes major long-term investments—for example, in land acquired for National Parks and wildlife refuges. Until now, climate change considerations have not been a factor in deciding whether any of these investments were necessary or prudent. Now climate change has the potential to threaten the value of some investments. In the case of lands acquired for conservation purposes, climate change will increase the value of a systematic policy for acquisition and protection. Thus, Congress could require that the land-acquisition and other similar proposals brought before it be accompanied by explicit evaluations of how climate change may affect the long-term viability of the parks and refuges.

Congress has increasingly linked policy direction to agency funding during the appropriation process. Congress could include requirements in its various appropriation bills that each of the agencies managing natural resources provide Congress with an evaluation of the agencies' preparedness to cope with a range of climate futures. The appropriation process may also be especially well-suited to encouraging agencies that implement climate-sensitive programs (e.g., disaster assistance, crop subsidies, and flood insurance) to develop long-term budget projections for those programs based on several future climate scenarios. In this way, a budget-conscious Congress can better inform itself early on about the growing financial costs that climate change may mean for those programs.

Reauthorization Cycle

Congressional action is heavily influenced by the reauthorization cycles of major Federal programs. The process of extending that authorization provides an opportunity to evaluate the workings of a program closely and to provide legislative direction for a period of many years. Thus, at least with respect to existing Federal natural resource programs, the best opportunities to implement the first steps may be in the context of laws and programs that are about to be reauthorized.

Among these, the Clean Water Act is a high-priority target of opportunity. Comprehensive revisions of that law have been proposed, and the act's wetland provisions are undergoing particular scrutiny. The reauthorization of the Clean Water Act provides a key opportunity to address an important need identified in the OTA report—the need to achieve more effective integration of resource-management efforts across political jurisdictions. Comprehensive watershed planning, which integrates wetland protection and restoration goals, water-use-efficiency goals, strategies for controlling point-source and non-point-source pollution, and both water-quantity and water-quality concerns generally, could create the institutional capability and flexibility to anticipate and plan for climate change. Such planning could be especially valuable for finding creative ways to resolve current threats to wetlands.

Another major target of opportunity is the upcoming reauthorization of farm programs in the 1995 Farm Bill. The next reauthorization cycle could provide a forum for considering how to enhance farmers' flexibility and effectiveness in responding to a changing climate and how climate change may affect Federal expenditures on disaster assistance and farm commodity support programs.

Amendments to Existing Statutory Language

Of the many Federal statutes pertaining to the management of the natural resource systems discussed in this report, only one—the Coastal Zone Management Act explicitly addresses climate change and its potential consequences. The 1990 amendments to that law required that possible sea level rise resulting from climate change be anticipated and addressed in State coastal zone management plans. Congress could extend this legislative precedent to other statutory arenas.

Several categories of legislation may be especially appropriate for considering possible climate-change-related amendments. First among these are statutes, that require long-range planning for the management of natural resources. For example, the Rangeland and Renewable Resources Planning Act of 1974 requires the preparation of a forest "resource planning assessment" that looks 50 years into the future. Similarly, the Clean Water Act requires preparation of area-wide waste treatment plans that look two decades into the future, a planning horizon also found in the Pacific Northwest Electric Power Planning and Conservation Act. In general, the

longer the time frame over which management is to be planned, the greater the likelihood that climate change may affect the resources being managed. Thus, mechanisms to ensure that climate change is taken into account when long-range plans are being developed and to ensure that plans can be revised as new information about the direction and magnitude of climate change becomes available are clearly desirable.

A second statutory area where it is especially important to ensure that potential climate change is considered is in laws related to long-term public or private investments. Public water-resource-development projects are governed by the Water Resources Planning Act and private ones are licensed pursuant to the Federal Power Act. The implicit assumption underlying both has always been that hydrological models based on past climate will accurately predict future conditions as well. The possibility of climate change casts doubt on the continuing validity of that assumption and may warrant statutory revisions explicitly requiring water resource planning agencies and Federal regulators to factor climate change into their decision-making.

A third statutory arena relevant here includes those laws that require an evaluation of the expected environmental impacts of planned actions. Foremost among these laws is the National Environmental Policy Act; similar, though less far-reaching, laws include the Fish and Wildlife Coordination Act and the Endangered Species Act. Under these and similar laws, expectations of the environmental impacts of planned actions may vary, depending on whether a constant or changing climate is anticipated. Legislative direction could provide useful guidance to agencies with respect to their duties to consider climate change possibilities in implementing their responsibilities.

A fourth set of laws that warrant discussion consists of those that authorize research programs. The Clean Water Act and the Rangeland and Renewable Resources Planning Act are examples. As this report makes abundantly clear, there are many uncertainties about climate change, including its magnitude, its direction, and its impact on natural resource systems. Natural resource management will require research aimed at resolving many of today's uncertainties. Reflecting that need in the legislative description of the various research missions may serve to underscore the importance of this area of inquiry. Each resource chapter highlights important research options to consider.

New Targets of Opportunity

In addition to the reauthorization of existing laws, Congress regularly considers altogether new legislation creating or modifying programs for existing or new agencies of Government. A program of potentially great significance is the new National Biological Survey. There exists an opportunity to shape the content and direction of this new institution in ways that would be useful to the management of natural resource systems in a changing climate.

The rationale frequently offered for creating a National Biological Survey is its potential, by cataloging the biological resources of the Nation and monitoring their status and trends, to avert future "train wrecks," that is, the disruptive and wrenching conflicts between conservation and development goals. A "train wreck" of another sort could take the form of severe adverse impacts on our natural resources from climate change for which we were unprepared. A National Biological Survey could help detect, evaluate, and prepare for that climate change. Thus, an important opportunity exists to structure the mission and capabilities of the survey so that it can contribute to the early detection of indicators of climate change, a better understanding of the ability of organisms and natural communities to respond to climate changes, and the design and management of a system of preserves best able to achieve the purposes for which they were established. Careful congressional attention now to these details in the design of a National Biological Survey could yield major returns in the future.

SUMMARIES AND FIRST STEPS

The Coastal Zone

The coastal zone may be the resource most vulnerable to climate change. In addition to being affected by higher temperatures, coastal regions would have to contend with changing sea level and could be subject to more-frequent or more-intense coastal storms. These could cause increased coastal flooding and erosion, higher storm surges, more wind damage, and saltwater intrusion into freshwater aquifers.

Even without climate change, the coastal zone is an area of greater than average climatic risk. Hurricanes and other violent coastal storms cause billions of dollars in property damage every year and are responsible for numerous deaths. Less dra-

matic, but ultimately very costly, is coastal erosion. A significant proportion of U.S. coastlines are eroding. Although erosion rates are highest during major storms, long-term erosion caused by the action of normal waves, wind, and tides adds much to the risks and costs of living in coastal areas.

Improvements in existing Federal and State programs that affect development and safety in the coastal zone are possible. However, several impediments to reducing risk exist. The very popularity of living in coastal areas is one. Increases in population and development in coastal areas have been dramatic in recent decades and, as a result, the exposure of people and property to natural disasters has steadily increased. Other obstacles include a perception that coastal subsidies are entitlements, a concern that some protective measures may unduly restrict private property rights, the perceived or actual cost of program changes, and the lack of coordination among coastal management institutions.

To help focus on where to start with responses to climate change in the coastal zone, some first steps that could be taken are listed below. A summary table of all other options can be found in an appendix to this testimony.

- *Revamp the National Flood Insurance Program.* The National Flood Insurance Program could be revised to provide stronger incentives to reduce the potential costs associated with high-risk development in coastal areas. Congress has been considering revising the NFIP for several years and bills to do this have been introduced in both the House and Senate during the 103d Congress. Most pressing is the need to adequately address erosion along the coast; erosion losses will increase with rising sea levels. The Federal Emergency Management Agency does not now have the authority to map erosion risks or to reflect such risks in insurance premiums, and as a consequence, information and incentives to avoid development in eroding areas are inadequate. It would also seem desirable to encourage mitigative action, by increasing insurance premiums, after multiple claims are made on properties in areas subject to high risks of repeated flooding.
- *Improve disaster assistance.* Several bills have also been introduced in the 103d Congress to revise disaster-assistance policies. More stringent disaster mitigation by States and localities could be required, which would hold down future costs to the Federal Government. This could be accomplished by more strongly tying disaster assistance to adoption of mitigation measures. If Congress wishes to reduce incentives for hazardous and costly coastal-development patterns, it could reduce the Federal share of disaster-assistance funds to States and communities, provide fiscal incentives for loss reduction programs, and tie disaster assistance to success in meeting performance criteria for State and local hazard-reduction programs.
- *Strengthen coastal zone management.* The Coastal Zone Management Act will be up for reauthorization in 1995, providing an opportunity to require stronger State controls on risky development. Such controls could include, for example, an erosion-setback program (already adopted by several States), restrictions on construction of immovable buildings, a relocation-assistance program, restrictions on rebuilding damaged or destroyed structures in high-risk locations, and adoption of minimum coastal-construction standards. Another possibility would be to encourage States to adopt coastal-hazards-management programs.
- *Require increased State and local contributions to beach-nourishment operations.* Changes in the U.S. Army Corps of Engineer's beach nourishment and shoreline-protection projects could also help limit exposure to coastal hazards. Most benefits of these projects are realized at the local or regional level, yet these projects are often heavily subsidized. In most instances, the Federal share is 65 percent. Greater State and local contributions could be required, both for initial construction and for maintenance, and Federal funding could be made conditional on adoption of stronger mitigation measures.
- *Promote public education.* The public generally is not well-informed about the risks associated with living in coastal areas, and this lack of awareness has led and will continue to lead to large public and private expenditures. H.R. 935 provides one possibility for expanding public education. The act authorizes education programs and provides funds to States to implement them through a self-sustaining mitigation fund. The private sector, particularly the private insurance industry, could also play an important role in increasing awareness of coastal hazards.

Water Resources

The abundance, location, and seasonal distribution of water are closely linked to climate. The potential for climate change to affect the status of the Nation's water

resources is likely to become of increasing concern. Exactly how climate change will affect water resources, especially regionally, is still unknown. Some areas could become either drier or wetter than they are now, with possible adverse consequences in either case. Although it is unlikely that recent droughts, floods, and hurricanes are linked to a changing climate, these extreme events do suggest what could become more common if climate changes occur in the way many scientists have forecast.

Many factors—including population growth, pollution, and inefficient use of supplies—are already straining the Nation's water resources and leading to increased competition among a wide variety of different uses and users of water. Also, human needs for water are increasingly in conflict with the needs of natural ecosystems. This stress is particularly obvious in the West, where a high percentage of available supplies has already been developed, but examples of conflict among uses for high-quality water occur throughout the country. As a result, the Nation faces a major challenge in adapting its water resource systems to meet projected future demands.

The following first steps toward improving water resources planning and management are intended to both relieve existing stresses and make sense for climate change.

- *Improve extreme-events management.* Perhaps the most important actions that should not be delayed concern improving the management of extreme events. Floods and droughts will continue to occur, whether or not they can be linked definitively to climate change. Improved flood and drought management now could help minimize both near- and long-term losses. Congress could direct the Executive branch to create an interagency drought task force with authority to develop a national drought policy and a similar body to establish national goals for flood plain management.
- *Promote better supply management.* Congress, could, for example, help make it easier to manage reservoirs jointly on a basin-wide level. New legislation could grant the Army Corps of Engineers and the Department of the Interior's Bureau of Reclamation greater flexibility to manage their reservoirs basin-wide and thus encourage development of a more integrated approach to water-quality, wetland, flood, and drought management. Congress could reestablish and strengthen Federal-State river basin commissions.
- *Support water marketing.* As long as adequate attention is given to protecting all affected parties, water markets could provide an efficient and flexible way to adapt to various stresses, including a changing climate. It would be very useful for Congress to clarify reclamation law on trades and transfers and define the Federal Government's interest in facilitating the creation of markets. Congress could urge the Department of the Interior to provide stronger leadership to assist with water transfers, and water marketing could be thoroughly evaluated as part of the Western Water Policy Review, authorized in late 1992.
- *Promote demand management.* Water conservation has great potential as a "new" source of supply. The Federal Government could set an example by adopting efficient water-use practices in its own facilities. The Energy Policy Act of 1992 requires that Federal facilities adopt conservation practices to the extent practicable, but it concentrates primarily on energy conservation. A technical-adjustment bill to the Energy Policy Act could provide a way to clarify and underline congressional intent toward water conservation in Federal facilities. The upcoming reauthorization of the Clean Water Act is one potential target of opportunity for improving water-use efficiency. Congress could consider making conservation projects eligible for the State revolving-fund loans created under the act to fund wastewater treatment plants.
- *Expand the scope of the Western Water Policy Review.* With the enactment of Title 30 of the Reclamation Projects Authorization and Adjustment Act of 1992, Congress authorized the Western Water Policy Review. This is to provide a comprehensive review of Federal activities that affect the allocation and use of water resources in the 19 western States. Water problems are not all in the West, so a more general review of national water policy may make sense. The Review could also provide an opportunity to evaluate land use practices and water resource issues jointly, closely linked issues that have rarely been assessed together in a major water study. Climate change is not mentioned as a factor motivating the Western Water Policy Review, but the study could provide an opportunity to assess more fully how climate change may affect water resources and to evaluate policy options that might help with adaptation.

Agriculture

Climate change could result in significant change in farm production. Worldwide changes in agricultural productivity may trigger market adjustments that lead to

changes in the distribution and intensity of farming within the U.S. Warming, itself might eventually shift the range over which major U.S. crops can be planted by some hundreds of miles to the north. Were there to be rapid shifts in the agricultural land base, there could be disruptions to rural communities and their associated infrastructures. For American farmers, already facing increasing competition, any relative decline in productivity could mean lost income.

If the United States wants to ensure its competitive position in the world market and to meet the growing demands for food without higher prices, public efforts to support the continued growth in agricultural productivity remain necessary. Climate change adds to the importance of efforts to improve the knowledge and skills of farmers, to expand the array of crops and production technologies available to farmers, and to remove impediments to adaptation by farmers. Efforts to expand the diversity of crops and the array of farm technologies will insure against a future in which existing crop varieties or farming systems fail. Efforts to enhance the adaptability of farmers—to speed the rate at which new farming systems can be adopted—lower the potentially high costs of adjustment to climate change.

The American agricultural sector will undoubtedly make adjustments in response to climate changes, with market forces rewarding and encouraging the spread of successful adjustments. However, impediments to adjustment to climate change are numerous. Water shortages may limit the potential for compensating adjustments in certain regions. The uncertainty of climate change also makes effective response difficult, as may eventual limitations on the availability of suitable crops and agricultural practices. The decline in the Federal Government's interest in agricultural research and extension is a problem; more-vibrant research and extension programs would certainly enhance adaptability. Certain agricultural programs may also increase the costs associated with a changing climate. For example, the commodity programs discourage the farmer from switching crops by linking support payment to the continued production of a particular crop. Restrictions on the marketing of conserved water may limit the incentive for efficient use of scarce water resources. Disaster assistance payments and subsidized crop insurance may limit farmers' response to increasing climate risks, increasing the potential expenditure on these disaster assistance programs.

The most pressing tasks concerning agriculture and climate change that the Federal Government should undertake are: a) removing the impediments to adaptation created unnecessarily by features of commodity support and disaster assistance programs; b) improving technology and information transfer to farmers in order to speed adaptation and innovation in farm practice; c) supporting research and technology that will ensure that the agricultural sector can deal successfully with the various challenges of the next century. The Government could organize its approach around the following first steps.

- *Revise the commodity support programs*—to allow greater responsiveness to changing climate and market conditions. Congress addresses farm issues every 5 years in omnibus farm bills. Congress should consider revisions in the commodity program that would allow greater flexibility in crop choice, breaking the link between farm support payments and the continued production of a single crop (e.g., by increasing the flex acreage allowance or introducing the normal crop acreage approach).
- *Modify the agricultural disaster-assistance programs.* Major revisions to the costly crop insurance and disaster payment programs are likely to be considered in the 1995 Farm Bill. In order to lessen the potentially high costs of these programs under a changed climate, these programs should be modified to provide farmers with greater incentives to limit their exposure to climate risk. Features of a restructured programs might include: reduced subsidies; limits on eligibility for disaster payments after repetitive losses; individual, local or state contribution to a disaster-assistance fund; and a merger of the crop insurance and disaster payments programs so that one program does not undercut the other.
- *Encourage research and development in farm-management systems.* Congress could act to enhance research in computerized farm-management systems. The competitiveness of the farm sector will increasingly depend on technological advances that improve the efficiency of U.S. farmers—rather than on further increases in mechanization and intensity of input use. Computerized farm-management systems will be increasingly important to the farmer's ability to increase yields, control costs, and respond to environmental concerns, changing markets, and new climate conditions.

Wetlands

The degradation and loss of wetlands is continuing, at slowed rates, despite an ambitious "no-net-loss" policy. The lack of clear statutory goals and fragmentation

of authority governing wetland protection continues to place these valuable systems at considerable risk. Sea level rise and changes in precipitation seem likely to exacerbate ongoing loss. Efforts to further reduce current wetland loss, to restore degraded wetlands, and to acquire and protect the most valuable wetland systems could lower the risk from future climate change.

Climate change is likely to accelerate the loss of vulnerable wetlands, especially the coastal wetlands, the wetlands in arid regions (e.g., the prairie potholes and riparian wetlands in the Southwest), and the tundra wetlands. The Federal Government could play a lead role in ensuring that these wetlands survive climate change. Policy levers exist, such as regulation and acquisition, incentives and disincentives, and research, that could help address the problem of climate-induced alteration of wetlands.

The revision of federal policies and programs can serve as a vehicle for mitigating the effects of climate change. Current threats to wetlands are aggravated by a fragmentation of existing institutional and geographical resources, a failure to adequately communicate the risks associated with wetland losses, a lack of planning in considering the potential effect of climate change on wetland systems, and gaps in information and research pertaining to the restoration of degraded or lost wetlands. Reviewing federal policies and programs that could be modified to address these problems and removing any existing incentives that might encourage wetland loss is an obvious target of opportunity to improving wetland regulation and protection.

Given the available policy levers, limited money to fund programs, and the level of scientific understanding of the impacts of climate change on wetlands, we identified the following strategies as first steps.

- *Revise the Clean Water Act.* The Act could be revised during its current reauthorization to improve the regulation and protection of wetlands. The present lack of a clear and specific mandate severely hampers wetlands protection. Current statutory language allows solely for the protection of wetlands that may be impacted by dredge and fill activities. This application could be expanded to allow for the regulation of all activities that may result in the degradation or destruction of wetlands.

  In the area of wetland mitigation banking, the CWA could be revised to establish uniform standards for mitigation activities. These activities should be closely monitored and evaluated. In the past, the concept of mitigation banking has been met with some discontent due to the inadequate tracking of success in restoring or creating wetland systems. Statutory language should require that mitigation projects restore not only lost wetland acreage but, more importantly, lost wetland function and value.¢

  Wetlands could also be better protected through the adoption of a watershed management approach to regulation. The implementation of watershed management schemes would allow for closer regulation of non-point-source pollution and a more integrated approach to achieving water-quality standards. The CWA should include wetlands in the scope of this broader water-quality framework.

- *Coordinate wetland efforts across agencies.* Coordination of effort is needed between Federal Agencies involved in wetlands protection and regulation. An array of federal agencies currently administers wetlands regulation and protection policies including the Fish and Wildlife Service, the Environmental Protection Agency, the Army Corps of Engineers, and the U.S. Department of Agriculture. The division of responsibilities and the inconsistency of goals and has led to great disparity in wetlands protection. There is an urgent need for coordination of effort between these agencies in setting goals for the protection, restoration, and acquisition of wetlands. The establishment of a priority plan for the oversight and administration of wetlands regulation and protection would allow for more sound decision making on Section 404 permits, land acquisition easements, and restoration projects.

- *Ensure that Federal policies and incentives are consistent with wetland protection.* The Fish and Wildlife Service should complete its comprehensive review (required under the 1986 Emergency Wetlands Resources Act) on the impact of federal programs on wetlands. Congress could then ensure that all Federal policies and incentives are consistent with wetland protection.

Federally Protected Natural Areas

Setting aside large areas of land to protect their natural qualities and processes has become a central strategy in preserving the American heritage. The Federal government has established several systems of reserved lands, such as the National Parks, the National Wilderness Preservation System, and the National Wildlife Refuges, and special management agencies (NPS, FWS, FS) to administer and protect

these valued resources. Climate change will shift the habitat range of plants and animals, but the boundaries of national forests, parks, reserves, and wildlife refuges are stationary. As species adapt to the new environment, migrate, or go extinct, some reserves may be "left behind," incapable of providing the benefits or serving the functions for which they were originally established, such as providing protection for rare species or supporting wildlife-related recreation. Limited understanding of ecological processes will hinder efforts to facilitate adaptation. Research on maintaining, restoring, and transplanting natural systems—research tasks that may require decades of effort—is needed. Strategic acquisitions of land, purchase of land easements, and innovative partnerships with adjacent landowners could enhance adaptability to climate change.

Landscape fragmentation of natural areas, institutional fragmentation of the forces governing natural areas, and lack of scientific information on ecosystem processes are impeding effective management and protection of natural areas, these impediments will be an even greater threat to natural areas with climate change. The management structure governing Federal lands is dispersed across several agencies that do not have any unifying goal.

Given the vast amount of uncertainty surrounding climate change and natural area responses, the most sensible ways to prepare for climate change in federally protected natural areas today are to (1) improve information gathering, and (2) enhance protection of federally protected natural areas and their resources. To even identify the effects of a changing climate, baseline data on current ecosystem structure and functions are needed. Additional research and monitoring are essential for informed decision-making about natural areas in a changing climate. Information is needed to help direct efforts in the acquisition of natural areas to optimize their long-term sustainability, to determine the sensitivity of species to climate, and to restore damaged natural areas to ecological productivity.

We have identified some strategies that represent inexpensive or useful first steps for facilitating adaptation to climate change in natural areas.

- *Direct management agencies to modify their criteria for land acquisition.* Federal land-management agencies should be directed to modify their criteria for land acquisition to include under-represented ecosystems, to account for long-term survivability, and to enhance current holdings by connecting or enlarging land parcels. By asking agencies to incorporate such concerns into future acquisitions, Congress could minimize future geographic fragmentation and use limited moneys to maximize the range of protected ecosystems.
- *Use the Fish and Wildlife Conservation Act of 1980.* This law established a Federal cost-share program for "nongame" species conservation. With some amendments to promote multispecies or ecosystem protection at the State level and adequate funding, the Fish and Wildlife Conservation Act could be used to encourage natural area protection and conservation on State and private lands.
- *Use the National Biological Survey (NBS) to assess ecological inventory and monitoring needs.* A Nationwide inventory and monitoring program with consistent and comparable inventory methods across all Federal and State agencies would help assess the state of the Nation's resources. Data from such an inventory could help facilitate regional planning and detect large-scale changes in natural areas.
- *Support basic research on key gaps in our understanding of ecosystems.* This research could include work on species sensitivity to climate change, restoration and translocation ecology, and the effective design of migratory corridors or protective buffer zones. Basic research in these areas is needed now to determine how best to provide for species protection in the future. At present, even if climate scientists were to determine the exact rate and nature of climate change, land-management experts would not know how to respond appropriately. Much of the research in federally protected natural areas is now focused on immediate management issues rather than on fundamental, long-term understanding.

Forests

Forests cover roughly one-third of the U.S. land area, shaping much of the natural environment and providing the basis for a substantial forest-products industry. Climate change may pose a significant threat, particularly to those forests that are not actively managed for timber production. Within a century, climate change might shift the ideal range for some North American forest species more than 300 miles to the north. As forests species are stranded outside their ideal climatic range, they could suffer declining growth and increased mortality from climate-related stresses such as insects, disease, and fires.

The most vulnerable forest resources are those in regions subject to increased moisture stress, as in the dry continental interiors. Forests in coastal regions may

be at risk from rising sea levels, with the threat of flooding and saltwater intrusion, or to increases in damaging wind storms. Forests or tree species with small or highly fragmented ranges, such as those at the upper elevations of mountains, may be lost. The potential threats that appear to be cause for greatest public concern are that there might be: (1) losses in species and in the genetic diversity of forests; (2) widespread damage from fires, insects, or disease; and (3) unanticipated dislocations within local or regional economies.

The Federal Government can prepare itself to respond to the threats that climate change poses to forests in several ways: by better understanding which forests are at risk (e.g., supporting research on species sensitivity to climate and monitoring changes in forests); by acting to avoid the potential loss of forest species (e.g., promoting and improving forest seed banks and forest-restoration techniques); by being ready to react promptly to the threat of large-scale forest mortality (fire prevention, pest management, silvicultural activity to improved forest health); through a redirection of incentive programs to encourage the improvement in the health of private forests; and by increasing the adaptability of the forest industry and forest-dependent communities to climate change through forest-products research and incentives for diversification.

Given the existing policy levers, limited money to fund programs, and the poor level of scientific understanding of impacts of climate change on forests, the following subset of policies are "first steps" that Congress could take. Each would help the Nation begin position itself to respond to the effects of climate change on both timber and non-timber forests. These options are justified now either because of existing problems that will be exacerbated by climate change, or because of the time required to complete the process.

- *Establish an expanded forest seed-bank program.* A rapid climate change could threaten the genetic diversity of our forest resource. A National effort in the conservation of forest seeds would help ensure against the potential for loss of genetic diversity in the forest resource. Congress could authorize and fund a National Forest Genetic Resources Program within the Forest Service, providing funds for seed storage facilities and for an enhanced forest genetics research program.
- *Develop strategic plans for responding to major forest declines.* Climate change may increase the risk of serious forest decline driven by fires and insect damage. Congress could provide a Forest Health bill that would establish criteria allowing prompt action to protect against threats of catastrophic mortality or to restore forests after large-scale mortality and decline. Such a bill might allow for the declaration of temporary forest health emergencies, under which accelerated actions to protect or restore forest health would be authorized—as long as these actions were consistent with established standards for protection of all forest values. A science and policy review group made up of academics and forestry professionals could develop criteria for undertaking actions to stem forest decline.
- *Prepare for a forest-management response to climate change.* A changing climate may eventually require innovations in forest-management and planting practices. Experimental efforts will be important in establishing a scientific basis for any necessary changes to future-management practices that might later be applied to public multiple-use forest land. Congress could support an expanded program of research on the Forest Service's Experimental Forests and other research forests to address adaptation to climate change. The research could be directed toward finding practical and environmentally appropriate techniques for managing the public forests that will help buffer or help them adapt to a changing climate.
- *Improve incentives for private management of forest lands.* The Federal Government controls only about one-quarter of the Nation's forest land. In the East especially, where Federal holdings are limited, efforts at supporting the protection of private forest land may take on increased importance. The Federal Government may use incentives, disincentives, and cooperative approaches to promote the health and productivity of this forest land. Traditional forest-support programs (e.g., the Forestry Incentives Program) target funds on the basis of potential gains in timber supply. Modifications of these programs might be considered to target funds to areas at high risk of insect and fire damage and to ecologically valuable forest lands, encouraging activity to maintain the health of the private forest lands and discouraging further fragmentation of forest lands. Expanding the role of the Forest Stewardship and Forest Legacy Programs might also serve to accomplish these goals.

APPENDIX: SUMMARIES OF POLICY OPTIONS, BY CHAPTER

COASTS: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Revamping the National Flood Insurance Program
- Raise premium rates for policyholders who receive subsidized flood insurance.
- Mandate erosion-management standards.
- Prohibit new insurance policies in risky locations.
- Increase insurance premiums after each claim on properties subject to multiple-flooding claims.
- Incorporate sea level rise into the NFIP mapping and rate structure.
- Expand relocation assistance.

Revamping Disaster Assistance
- Reduce the Federal share of public assistance.
- Tie disaster assistance more strongly to State and local hazard-reduction programs.
- Consider ability to pay and extent of damages.
- Eliminate public-assistance funds.
- Through oversight hearings, Congress could review the criteria used by the President to declare disasters.

Extending and Expanding the Coastal Barrier Resources Act (CoBRA)
- Further limit subsidies.
- Expand coverage to other sensitive lands.
- Encourage the development of State CoBRAs.
- Acquire undeveloped areas.

Revamping the U.S. Tax Code
- Eliminate or reduce tax benefits for coastal development.
- Modify the Tax Code to support and encourage mitigation.

Strengthening State and Local Coastal Management
- Mandate certain specific—and stronger—minimum development controls.
- Expand available resources.

Shoreline Protection and Beach-Nourishment Programs
- Discourage permanent shoreline stabilization where feasible.
- Increase State and local contributions and phase out Federal funding of beach-renourishment programs.
- Make the Federal proportion of funding for renourishment projects conditional on adaptation of certain State and local coastal-management initiatives.

FORESTS: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Avoid potential losses in forest biodiversity
- Establish an expanded forest seed bank and forest genetics research program.
- Use the Experimental Forests for research on adaptation to climate change.
- Encourage diverse management practices on portions of the public forests as a buffer against climate change.
- Actively protect certain highly valued forest sites.
- Provide incentives to reduce fragmentation of private forestland (e.g., through the Forest Stewardship, Stewardship Incentive, and the Forest Legacy Programs).

Prepare for the threat of large scale forest decline
- Use existing monitoring and inventorying efforts to identify causes and effects of forest decline.
- Provide a Forest Health Bill that establish appropriate criteria for management activity to protect or restore forest health on Federal lands.
- Increase fire- and pest-prevention activities.
- Ensure that potential restrictions on below-cost sales do not prohibit activities needed to maintain forest health.
- Provide incentives and information to private forest owners to reduce hazards and to improve forest health.

Prepare to minimize the potential for economic dislocations
- Incorporate climate change scenarios into forest plans and assessments.
- Eliminate the even-flow-harvest requirement of the National Forest Management Act (NFMA).
- Increase flexibility in the timber industry, through greater support for research and development in forest products technologies.

- Increase flexibility in forest-dependent communities through programs to support diversification of forest-dependent rural economies.

WATER: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Institutional
- Resurrect the former Water Resources Council.
- Reestablish and strengthen Federal-State river basin commissions.
- Create an interagency task force to develop a national drought policy.
- Create a National flood-assessment board.
- Integrate floodplain management into basin-scale planning.

Research and Development
- Fund the development and use of water conservation technologies.
- Fund the development and use of wastewater reclamation technologies.
- Increase funding for development and promotion of new analytic tools.
- Incorporate flexibility into the design of new structures or rehabilitation of old ones.

Direct Federal Levers
- Revise the tax code to promote conservation investment.
- Provide stronger leadership to facilitate water transfers.
- Clarify reclamation law on trades and transfers.
- Reduce Federal obstacles to interstate transfers.
- Clarify the rules regarding the marketing of Indian water.
- Allow Federal agencies to buy water for environmental purposes.
- Expand the scope and nature of the Western Water Policy Review.
- Conduct post-drought audits.
- Direct the Interagency Floodplain Management Task Force to promote the preparation of State floodplain-management plans.

Economic incentives and disincentives
- Allow state revolving-loan funds to be used for conservation investments.
- Reform pricing in Federal water projects.
- Tie funding of State water projects to adoption of improved water and management practices.
- Encourage adoption of risk-management and -minimization practices to mitigate drought effects.
- Use legislative reauthorizations to integrate preservation and restoration of wetlands.

Operational
- Encourage water conservation in Federal facilities.
- Require operating agencies to undertake periodic audits to improve efficiency.
- Give Federal operating agencies greater ability to modify project operations to meet changing conditions.

AGRICULTURE: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Revise commodity support programs to remove the financial penalties on switching crops
- Allow farmers full flexibility in crop choice without loss of program benefits (i.e., the "normal crop acreage" approach).
- Partially increase the proportion of acreage (the flex acreage) on which farmers can now switch crops without loss of program benefits.

Modify disaster assistance programs to ensure that farmers will respond with precaution and innovation to the changing climate risks
- Provide disaster assistance only for unusual losses; limit the number of times that disaster payments can be collected.
- Modify or combine the disaster payment and crop insurance programs so that one program does not continue to undercut the other.
- Provide a self-insurance program for farm income stabilization (modeled on the Individual Retirement Accounts).

Support research and technology to ensure that agriculture can deal successfully with the various challenges of the next century
- Enhance research on and development of computerized farm-management systems.
- Support agricultural biotechnology and genetics.
- Support conventional crop-breeding programs.
- Increase support for the development of new commercial crops.

Improve information and technology transfer in order to speed the process of adaptation and innovation in farm practice

- Expand farmer involvement in the research and extension process with increased support for on-farm experimentation.
- Develop a database on successful farmer responses to changing climate conditions.

Address planning needs

- Broaden the focus of the periodic assessments authorized under the Resources Conservation Act.

WETLANDS: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Use the existing regulatory framework

- Implement and oversee the no-net-loss policy.
- Expand coverage and strengthen enforcement of section 404 of the Clean Water Act.
- Target acquisition programs to wetlands that may be lost soon.
- Design Federal projects to incorporate climate change predictions and to safeguard water and sediment flow to wetlands.
- Augment and coordinate monitoring of wetlands.
- Pay to protect wetlands on private lands.
- Allow trading of regulatory or tax obligations for wetland protection.
- Eliminate incentives to destroy wetlands.

Restore degraded or converted wetlands

- Fully fund existing restoration programs.
- Increase government oversight of restoration and mitigation; require that projects set goals to monitor and evaluate success.
- Use opportunities to restore and preserve reclaimed wetlands.
- Remove hard engineering structures that degrade wetlands, where feasible, and attempt to restore normal water and sediment flow.
- Use the Dredged Materials Program to facilitate wetland restoration.
- Target key sites for a wetland restoration program.

Facilitate migration

- Require building setbacks from coastal and riparian wetlands.
- Identify the wetlands that are most able to migrate and sites to which they could migrate.
- Acquire land important for migration (including buffer zones).
- Reduce Federal subsidies, such as Coastal Zone Management (CZM) funds and flood insurance, in areas that have not established setback or "planned-retreat" policies.

Improve coordinated management, monitoring, and research

- Identify and assign priorities to the wetlands that are most important to protect and restore.
- Clarify national goals for wetland protection.
- Ensure that Federal policies do not inadvertently lead to loss of wetlands.
- Promote integrated resource management at the watershed level.
- Use legislative reauthorizations to integrate preservation and restoration of wetlands.
- Support long-term research and monitoring on the impacts of climate change on wetlands.

PRESERVES: SUMMARY OF OPTIONS TO IMPROVE ADAPTATION

Gather strategic information

- Increase funding for the "Ecological Systems and Dynamics" research area in USGCRP.
- Make research on natural resources a key component of a broadened global change program.
- Direct NAS, OSTP, or an independent commission to assess the applicability of ongoing environmental research to provide long-term guidance for natural resource protection.
- Support coordinated research in federally protected natural areas.
- Create a national program for inventory and monitoring.
- Create a line item in agencies' budgets for inventory and monitoring activities.
- Direct agencies to identify principal gaps in inventory and monitoring activities within existing programs.

- Support programs that have the most urgent inventory and monitoring needs.

Enhance protection of natural areas

- Direct agencies to modify their criteria for land acquisition to include underrepresented ecosystems, long-term survivability, and connecting and enlarging land parcels.
- Increase appropriations for the Land and Water Conservation Funds to give States and agencies more power to acquire land and provide easements.
- Use current conservation incentive programs administered by the Secretaries of Agriculture and Interior to enhance the Federal effort to protect natural areas.
- Encourage ecosystem-level conservation at the State level by funding the Fish and Wildlife Conservation Act of 1980.
- Use "cooperative research and management funds" to foster cooperative management among agencies.
- Create a Federal Coordinating Council for Ecosystem Management.

OFFICE OF TECHNOLOGY ASSESSMENT,
WASHINGTON, DC 20510–8025,
May 5, 1994

THE HONORABLE JOSEPH I. LIEBERMAN,
Chairman, Subcommittee on Clean Air and Nuclear Regulation,
Committee on Environmental and Public Works,
United States Senate,
Washington, DC 20510–6175

DEAR MR. CHAIRMAN. Following my testimony before your Subcommittee on April 14, 1994, I received two written questions to be answered for the record. I am enclosing a copy of those questions and my response. I hope you find the response useful, and thank you for the opportunity to help your Subcommittee.

Sincerely,

MICHAEL D. BOWES,
Senior Analyst.

Enclosure.

RESPONSE TO WRITTEN QUESTIONS FROM SENATOR LIEBERMAN

Question 1. What is the current total cost of protecting the coastal zone? How large is the Federal share of this cost? Will the costs of protecting our coasts rise just like the projected rise in sea level?

Answer. Over the past 3 years, the U.S. Army Corps of Engineers has spent an average of $38 million annually for beach nourishment and structural protection measures. Federal cost sharing is 65 percent for the majority of these projects that are designed to prevent physical damage to property. When costs covered by States are included, total expenditures on Corps shore-protection projects have been about $62 million a year over the past 3 years. There are other shoreline erosion projects undertaken directly by the States and by private property owners, but no estimates of total expenditures on those efforts are readily available.

So far, relatively little of our coast line has been covered by Federal shore-protection activity—only 226 miles out the 2,700 miles of coastline considered to be facing critical erosion. If sea-levels were to rise by 1 meter over the next century, an increasing length of coastline would require beach nourishment or structural protection. Structural flood-protection measures would eventually become necessary to protect barrier islands and urbanized areas of the mainland coastal zone. The Corps of Engineers provided OTA with estimates of the potential future costs of beach nourishment and flood control. These estimates, which were intended to be conservatively high, show costs rising to $150 million per year by the first two decades of the next century and then increasing dramatically to about $1.5 billion a year by the middle of the century as major flood protection projects become necessary. Cumulative costs (undiscounted) over the next century were estimated by the Corps to be almost $120 billion.

There are many other costs associated with protecting the coastal zone that could also be affected by rising sea levels. The Federal Emergency Management Agency (FEMA) administers the Flood Insurance Program which provides financial protection against shoreline erosion. Over recent years FEMA has spent about $300 million a year administering and subsidizing the insurance program in coastal areas.

The potential Federal obligations under this program could rise significantly with rising sea levels. Other measures, such as land use regulation, local building codes, coastal zone planning, and hazard mitigation efforts, serve to reduce the vulnerability of structures in the coastal zone. Overall costs of the resulting defensive measures are not readily available, but costs seem likely to rise.

Question 2. The OTA report does not specify whether these large expenditure to cope with rising sea level would be successful? Would these proposed expenditure allow us to completely protect our coastline?

Answer. No, the expenditures would not result in complete protection of the coastline. The estimates are based on the assumption that only the more highly developed and valued portion of the coastline would be protected (some 1900 miles in total). Retreat and land loss might result elsewhere. In addition to the costs associated with retreat, rising sea levels could have other ecological and economic impacts, some of which might not be easily overcome. Among the concerns are the possibility of salinization of groundwater in the coastal zone. This would increase costs for urban water supply systems and could also be damaging to agriculture. The potential flooding and loss of coastal wetlands is a primary concern. A major loss of coastal wetlands, which many fear is possible, would have great impact on some commercial fisheries and on wildlife in general. The loss of buffering provided by wetlands, could also increase coastal vulnerability to storm surges.

SOUTH CAROLINA SEA GRANT CONSORTIUM,
CHARLESTON, SC 29401,
May 20, 1994.

MR. BOB NIBLOCK,
Program Manager, Oceans and Environment Program,
Office of Technology Assessment,
600 Pennsylvania Ave, S.E.,
Washington, DC 20003

DEAR BOB. I hope the information is useful.

Sincerely,

MARGARET A. DAVIDSON.

Enclosure

QUESTIONS AND ANSWERS TO CLIMATE CHANGE

Question 1. Mr. Bowes testified that OTA recommends "low regret" options—those that address existing problems and inefficiencies as well as helping protect against the uncertainties posed by climate change.

In your opinion, in regards to sea level rise, what are the best "low regret" options?

Answer. There are several "low regret" options to consider. Gradual retreat from the coast using an erosion-setback program is one option that has already being adopted in some states, including South Carolina. Additionally, local building codes can be altered to reflect the risks of coastal development, for example by restricting allowable building heights or requiring new construction in the V zone to meet certain design standards. At the Federal level, The Coastal Zone Management Act, when reauthorized, could include provisions for restrictions on construction of immovable buildings, a relocation-assistance program, restrictions on rebuilding damaged or destroyed structures in high-risk areas, and adoption of minimum coastal construction standards.

Revamping the National Flood Insurance Program to adequately address erosion along the coast is an important step. Also, it would be desirable to reduce the insurance subsidies found in the program which encourage risky coastal development. Another financially based option would be to do away with the casualty loss option that the IRS allows.

Finally, for beach nourishment projects, greater state and local contributions to the cost of construction and maintenance could be required. Ideally, the costs of renourishment would be borne by beach-front communities and property owners. The argument can be made that renourishment is a maintenance cost and is therefore not eligible for Federal funding. Sources of local funding could be a dedicated sales tax or a tourist tax. Additionally, if Federal funding continued, it could be made conditional on adoption of stronger mitigation measures. These could include setback requirements, post-disaster restrictions, and relocation assistance.

Question 2. The OTA report stresses that policies for adaption to climate change, including sea level rise, should be flexible and robust.

In your opinion, are these characteristics being built into State coastal policies? Are there any specific issues or areas of concern that are not being addressed by current State or Federal programs?

Answer. While a large number of states have officially recognized and assessed the problems and issues of sea level rise in their CZMP's, only a handful have put forth new policies, including Maine and South Carolina. Several more have existing regulations which put restrictions on coastal development that are adaptable to sea level rise. There are several strategies that states can use to implement policy which responds to sea level rise. Zoning laws, economic incentives and disincentives, development restrictions, and nonstructural engineering methods are all being utilized.

As far as specific areas of concern that are not being addressed by State or Federal programs, the main problems revolve around wetlands. A problem that exists in general, but is particularly important in regards to sea level rise, is that there is not a comprehensive wetlands protection program. There are several Federal and many State agencies that have some policy jurisdiction over wetlands. Part of the problem is that no single Federal statute is directed at protecting, restoring, and acquiring wetlands, and there is no coordinated effort to monitor and evaluate them. Also, few programs for wetland acquisition and restoration address the possibility of climate-induced alteration of wetlands. One suggestion that takes climate change into account is mandating buffer zones around coastal wetlands that would allow for landward migration as sea level rises.

Question 3. You suggested that one high-priority step that should be taken in the near future would be to provide better tax incentives for granting conservation easements on coastal beaches and wetlands.

Could you give me an example of how you might structure this? Are any states doing something similar in their tax codes?

Answer. One possible tax incentive for conservation easements would be to eliminate estate tax for people who wish to donate their land. This is currently a provision of the proposed Rural Lands Conservation Act (SB1013).

Question 4. You testified that Maine, North Carolina and South Carolina have banned the construction of hard shoreline stabilization.

What has been the experience of these states to date with this policy? Have there been large areas of erosion that have affected shoreline structures? Have there been any legal challenges to these rulings?

Answer. The banning of shoreline stabilization structures is, in general, a reasonable management tool. The main drawback to it, and most likely the reason why more states have not enacted similar legislation, is that such a ban is only feasible in certain locations. The states that have enacted hard structure bans have historically been less developed on their coasts. North Carolina's law has been effective because it has been in place for a while, and the Outer Banks have not faced the development pressure that some of the northeastern coast has.

The banning of hard stabilization structures generally goes hand in hand with a retreat policy, and the coastal areas of most states are so highly developed already that retreat is not discussed as an issue, and banning, of protective stabilization structures isn't viewed as an option.

In North Carolina, house moving has been a more effective management tool than hard structure banning. That is basically because the cost to property owners of moving their homes further inland is not as expensive as putting a seawall in would be. The house moving and seawall banning plans work in North Carolina because the coastal towns on the Outer Banks are mostly low density with small buildings, and growth that is controlled by local ordinance.

PREPARED STATEMENT OF MARGARET A. DAVIDSON

Mr. Chairman, members of the subcommittee, my name is Margaret A. Davidson, executive director of the South Carolina Sea Grant Consortium. I am pleased to be here today on behalf of the Advisory Panel for the Office of Technology Assessment to present the contents of their report entitled Preparing for an Uncertain Climate.

As a member of that advisory panel and as a resource professional who works with citizens, businesses and public agencies in our rapidly changing coastal areas, I believe that the advisory panel's deliberations were most thoughtful and are well represented by the recommendations contained within the report.

As this subcommittee well knows, there is a wide range of opinions about the specific interactions of our climate and effects which we may feel in the future. How-

ever, one fact, about which there is widespread agreement, is that our coastal areas will be increasingly and adversely affected by greater climate variability and change. In fact, many knowledgeable people feel that our coastal areas are the most vulnerable to natural climate variability, let alone the extreme impacts which will most likely occur from sea-level rise and other climate change.

Already, the coast is regularly buffeted by coastal storms, and plagued by coastal erosion and an increase in rate of the rise of relative sea level.

Hurricanes and other violent coastal storms cause hundreds of millions of dollars in damage every year and are responsible for numerous deaths. Less dramatic than the destruction of property by storms but quite costly on a regular basis is coastal erosion. We know that a significant portion of the U.S. coastline is eroding. Even our undeveloped coastal areas, including barrier islands and marshlands, are vulnerable to both the effects of climate variability and change as well as human encroachment.

DEMOGRAPHICS AND ASSOCIATED COSTS

Our nation's oldest and largest centers of population, like those in most countries, are along the fringe between the land and the water. In the past 30 years, the population of coastal counties throughout the nation has grown by approximately 40 percent—this trend is expected to intensify over the next two decades and is likely to affect the most sensitive coastal areas such as barrier islands, beachfronts, and coastal wetlands. Currently nearly half of the nation's population lives within the 10 percent of the land found around the nation's shorelines—population density in these areas is more than four times the national average.

With this explosive growth has come investment, development and a corresponding increase in the exposure of property to natural disasters. Relative (per capita) investment in infrastructure and building stock is greater in these areas than in any other parts of our country. In the southeastern coastal states, insured property exposure has grown by nearly 50 percent in the decade of the 1980s. The decline in numbers of insurers and increases in coastal premiums by those remaining in the insurance industry since Hurricanes Hugo, Andrew and Iniki is, in part, a reflection of the realities of this increased exposure.

Climate-related events in our coastal zones entail a larger-than-average risk, yet, we as a nation have come to feel that we are entitled to be both protected from and insured against the results of our decisions to develop and live in high-hazard coastal areas. Federal programs intended to aid the unfortunate who suffered major losses in these areas have grown into the virtual equivalent of "entitlement" programs. And our notions regarding the sanctity of private property have led us to the point where government must move carefully when it does try to minimize its costs of subsidizing our poor choices. Because development decisions are not easily reversible and the results of our decisions will be with us for many decades, it seems prudent to begin an examination of current and potential policies regulating activity in climate-sensitive coastal areas.

CLIMATE CHANGE PROBLEMS AND ASSOCIATED COSTS

Introduction

Climate change will most likely affect the coastal zone through increases in sea level and storm activity (hurricanes, storm surges, flooding, and erosion) and changes in patterns of precipitation. Developed and natural (especially wetlands) coastlines will be affected.

Coastal development is more or less strictly regulated, but wetlands are not subject to any single comprehensive federal law. Wetlands are "protected" by an amalgam of 6 statutes with direct impact, 19 statutes with indirect impact, two Executive Orders, and various programs and regulations spawned by these statutes and orders. In addition, many states and some municipalities have enacted laws to protect wetlands—some more strict than the federal programs. The sheer magnitude of these various approaches does not, however, ensure protection of the rebuilding and migration requirements of wetlands affected by climate change—a vital issue that must be addressed.

Among all the aspects of climate change and associated effects, that which is most certain in that the rate of rise of the relative sea level will continue to increase arithmetically or exponentially. According to the Intergovernmental Panel on Climate Change, sea level could rise another 10 inches or so in the next 50 years, 26 inches over the next century. That increase will have major consequences for our coastal populations, our coastal investments as flooding and erosion increase. This problem would be the greatest along the Atlantic and Gulf of Mexico shorelines (although certainly our colleagues in the Great Lakes have had a recent lesson about

what happens with increases in relative water levels). The Pacific coast is generally less vulnerable to sea-level rise (as well as erosion). Accelerated sea level rise will also be accompanied by saltwater intrusion which may alter or destroy coastal wetlands. The only way that wetlands will be able to adapt to climate change is through migration moving inland to keep pace with the rising sea; sedimentation that flows to the sea through our riverine systems will provide nourishment for impacted wetlands as well. Regrettably, our tendency to develop and harden our shorelines will restrict the ability of coastal wetlands to migrate.

The Federal Emergency Management Agency (FEMA) suggests that the number of households subject to flooding would increase from about 2.7 million now to almost 6 million over the next 100 years.

Storms

There is an increasing body of scientific investigation that suggests that increases in carbon dioxide may lead to increased frequency of tropical storms. There is other work to suggest that increases in the temperature of the surface of the ocean—which we have already documented in the Indian Ocean—may lead to increased intensity of tropical storms. Clearly, the likelihood of global warming and its contribution to more several coastal storms is an important area requiring further scientific investigation and public consideration.

Accelerated sea-level rise combined with standard patterns of tropical storms will exacerbate current losses of property and current losses of coastal wetlands. Again, the southeastern and Gulf of Mexico areas are most vulnerable—partly because these areas are already experiencing subsidence.

While we have improved weather forecasting, prediction and warning systems, and evacuation plans, increased coastal population growth will offset our technological gains of the past century and increase the potential for loss of life.

Various studies have attempted to estimate the possible costs of protecting U.S. coastlines. The average estimate of $100 billion (in 1992 dollars) is simply a ballpark estimate several factors may change the ultimate costs: (1) exposure to risks and appropriate responses are, of course, site-specific; (2) the $100 billion estimate does not include the likely substantial damage to the natural environment such as loss of wetlands and declines in biodiversity; and (3) we cannot be exactly sure how human activities outside the coastal zone, such as the construction of dams and reservoirs, will exacerbate impacts by interrupting natural, mitigative processes.

Costs associated with coastal storms have been tremendous. Repairs from Hurricane Hugo required $1.6 billion in federal disaster relief. Hurricane Andrew's estimated cost to the Federal Government was $2.1 billion and to private property insurers was over $6 billion—those figures do not include losses to uninsured property, the cost of emergency services, incidental losses, or property insured under the National Flood Insurance or Small Business Administration programs. Nor do the total attributed costs associated with Hurricane Andrew of more than $30 billion account for lost wages and time, or intangible such as environmental damage which was considerable. When we consider the staggering costs occasioned by the resumption of normal patterns of hurricane activity in the past 5 years, let us also remember that as devastating as Hugo, Andrew, and Iniki were, none of those three storms hit a major population center.

What is clear is that we seem to have a propensity for the islands and shorelines which are most likely to be injurious to our health as well as our pocketbooks.

How Did We Get Here

We got into this state of extreme exposure to coastal risks through web-intended public policies which had adverse unforeseen consequences. Historically, government has subsidized coastal development, both directly and indirectly. In particular, four important programs address the risks of living in the coastal zone: (1) the National Flood Insurance program (NFIP), (2) Federal disaster assistance, (3) Federal beach-renourishment and shoreline-protection programs, and (4) the U.S. Tax Code.

NFIP

Pursuant to the NFIP, there are currently about 2.6 million flood policies in effect, representing nearly $230 billion of insurance exposure for the Federal government. More than 70 percent of NFIP policy holders are located in coastal communities—and their property values most likely represent more than 70 percent of NFIP's total holdings.

After severe criticism, the NFIP became more nearly self-supporting in the mid-1980's. Rating and coverage changes made during the mid-1980s enabled the program to build up cash reserves in years when losses were less than the historical average.

Now, however, with a return to more normal frequencies of hurricanes and other heat-associated storms, the probability of exceeding the reserves in any given year is high. Indeed, after Hurricane Andrew, Congress found it necessary to authorize an expansion of the Federal Insurance Administration's capacity to borrow funds from the Treasury to cover NFIP payouts.

The OTA study report points out two major problems with implementation of NFIP that remain:

(1) The majority of insured property owners in coastal high-hazard areas receive insurance at subsidized rates. And repetitively damaged properties represent a major problem for the NFIP: over 40 percent of all flood-insurance claims have been for properties damaged more than once, yet FIA does not have the authority to cut off or substantially restrict future coverage for such properties.

(2) NFIP does not take long-term erosion trends into consideration when setting rates. Because the program pays claims for erosion damage, there is, in essence, a hidden subsidy of these ubiquitous erosion risks

Federal Disaster Assistance

In addition to NFIP, the Federal Government has been involved for many years in assisting state and local governments respond to, and recover from, natural disasters. During a period of less frequent storms than average (1978–1988), FEMA reports that approximately $89 million was spent by the Federal Government as a result of hurricanes and coastal-storm events. These disaster-assistance moneys provide a significant subsidy for coastal communities, underwriting various potentially risky coastal public investments. This system has no provisions that encourage high-risk communities to place public facilities in safe locations or design them in ways that minimize future vulnerabilities. Several examples follow.

Although Presidential disaster declarations are only to be issued in severe cases, the issuance of these declarations is increasingly pro forma—even when damage levels are relatively modest. Further, there has been a disturbing trend in recent years to waive the cost-sharing requirements for local and state governments; after Hugo and Andrew, the Federal Government agreed to cover 100 percent of the costs of eligible public-sector damages.

Federal Beach Nourishment and Shoreline Protection Programs

Federal beach nourishment and shoreline protection programs also utilize general tax revenues and contribute to increased investments in high-hazard areas. The Federal Government, through the Army Corps of Engineers, has subsidized shoreline-protection projects for decades, even where "protection" in one area may exacerbate erosion in another. The largest benefit of these federal expenditures are clearly the local and regional communities and economies.

U.S. Tax Code

Several major coastal-development subsidies are also available via the U.S. Tax Code. The casualty-loss deduction has assisted many a coastal property owner who has either inadequate flood insurance or none. Further, the deductions for second homes and accelerated depreciation schedules for rental properties which constitute much of coastal development contribute to the artificial attractiveness of these areas.

However, recent efforts to reform these and other Federal disaster assistance programs have met with stiff opposition by local and State, officials and owners of property in high-risk areas.

There are a host of other federal programs that also contribute to subsidizing development in our high-hazard coastal areas. Extensive funding for the constructions of bridges, for instance, by the Department of Transportation played a major role in the development of barrier islands.

Why We Resist Change

Coastal areas continue to attract people like magnets, even in the face of perceived risk for several reasons: (1) the anomalous period from the late 1950s to the late 1980s when we experienced a low frequency of coastal storms contributes to the seeming willingness to risk these hazards; (2) the high property values associated with beach front properties do, of course, contribute to their investment attractiveness; (3) some coastal protection programs (such as flood insurance, beach protection, and disaster assistance) have, over time, acquired the aura of subsidies and social entitlements; and (4) the use of the legal system by property owners against those units of government which restrict coastal development or wish to retrench from their public subsidies of high-hazard coastal living.

Clearly, it is time for our nation to undertake a careful and comprehensive review and update of the balance between private property rights and public interests and environmental protection. Of course, changing the status quo of coastal zone management will be difficult and costly.

The greatest obstacle towards better decision making in our high-hazard coastal areas is the sheer number of governmental programs, spread across the Federal and State governments.

The various federal programs and initiatives are not well coordinated and there is no unified, comprehensive strategy for reducing the risks of living on the coast, now or in the future.

Few coastal states or communities prohibit development within floodplains. Only a handful of states have adopted fairly stringent coastal setback requirements, and generally these are based on long-term erosion rates rather than on estimates of erosion, rates resulting from increases in the rate of relative sea-level rise.

In many coastal areas building codes are simply not required, even though it has been repeatedly demonstrated that we can help protect structures in the high-hazard environment of our coastal areas.

Of course, the potential costs associated with changing the many federal programs may itself present an obstacle. Coastal land acquisitions may entail major expenditures. In contrast, adoption of coastal building standards actually involves a relatively small increase in the cost of home construction, particularly as compared to the potential savings in storm damage expenses. In some cases, such as the Upton-Jones relocation assistance, the initial cost may be substantial but the long-term benefit is a reduction in the potential outlay for damage costs. We also need to work out a method to account for the potential reduction in environmental damages.

What the States Are Doing

The 1972 enactment of the Federal Coastal Zone Management Act (CZMA) served as a major catalyst for improved coastal planning and management. This was a case of the Federal Government providing incentives for the development of state coastal-management programs. In addition to the financial incentive for participation, States were also encouraged to participate as a way of exercising some degree of control over Federal actions and projects in their coastal areas.

While there is considerable variation in the specific approaches which the various states have taken, compared with the state-by-state management framework that existed before CZMA, there is little doubt that current coastal development patterns and practices are more protective of sensitive coastal resources and have reduced the exposure of people and property to coastal risks. Some states have clearly made major strides in reducing the risk of development in our high hazard coastal areas.

Of the 29 coastal states participating in the CZM program, at least 13 now impose some form of coastal setback, requiring new development and reconstructed buildings to locate a certain distance landward of the ocean. Generally, these setback requirements are calculated according to local erosion rates. North Carolina, requires a setback of at least 30 times the average annual rate of erosion for that particular stretch of coastline; if the structures are large, the setback is doubled to 60 times.

North Carolina, South Carolina, and Maine have banned the construction of hard shoreline stabilization structures altogether. These restrictions serve not only to reduce destruction of beaches, but also ensure that there may be sufficient area for landward migration of marshes as the sea rises.

Other States have begun to explicitly incorporate consideration of sea-level rise into their programs. Seventeen coastal states have officially recognized the problem of sea-level rise and have undertaken assessments of the issue. Eleven of these have initiated new public and intergovernmental processes (e.g. forming a sea-level rise task force), and 13 states have existing regulations that are adaptable in one form or another to address future sea-level rise, such as coastal setbacks. Maine ensures that wetland buffer zones are established in anticipation of wetland migration; additionally, in certain areas, structures exceeding a minimum size must take into account a predicted 3-foot rise in sea levels over the next 100 years.

Several states require real estate disclosure, specifying the hazardous nature of coastal properties. But perhaps, the most important change has been the adoption of stricter building codes and standards designed specifically for the high-hazard conditions of our shorelines. Local enforcement may, however, be limiting. For while the South Florida Building Code was considered one of the strongest prescriptive codes, damage inspections after Hurricane Andrew, however, revealed deficiencies in application and enforcement of the code.

CZMA has also been effective in protecting coastal wetlands, both through direct prohibition on destructive activities as well as through the encouragement of local land-use controls and planning. Many local areas now appreciate the important role

that wetlands play in stormwater management. A number of states, such as Maryland, have enacted setbacks and buffer requirements to protect coastal wetlands.

Small Steps Taken by the Federal Government

As I mentioned earlier, there have been some promising moves to minimize the degree to which national programs subsidize development and construction in high-hazard coastal areas.

For instance, Section 1362 Flooded Properties Purchase Program of the National Flood Insurance Act allows FEMA to break the repetitive damage cycle by "buying" damaged properties. Regrettably, the limited funds allocated for this program restrict its use in high-value coastal areas.

The Upton-Jones Amendment to the Housing and Community Development Act of 1987 takes another tack by providing for subsidization of the demolition or relocation of shoreline structures that are "imminently" in danger from erosion. Again, unfortunately, a lack of funding plagues this approach.

While there has been some improvement in the federal disaster-assistance framework, recent efforts to reform various programs have met with strong opposition by local and state officials and owners of property in high-risk coastal areas.

Future Steps Which the Federal Government Should Take

Current management concerns are shaped by present environmental conditions—climate changes will only exacerbate modern resource management dilemmas. The OTA report presents 22 options for improving the allocation and management of risk in coastal areas. Below are several of the highest-priority, relatively low-cost, no-regrets steps which we should take.

(1) Congress should make program and policy changes to the NFIP to reduce subsidies and otherwise improve flood-mitigation activities. Options include: raising premium rates—particularly after claims, mandating erosion-management standards—such as setbacks; prohibiting the issuance of new insurance policies in risky locations; incorporating sea level rise in the NFIP mapping and rate structure; and expanding relocation assistance. A number of bills incorporating some of the recommended changes are under consideration by Congress.

(2) The existing disaster-assistance framework should be modified in several ways to reduce incentives for hazardous and costly coastal development patterns. These include: reducing the federal share of public assistance; tying federal disaster assistance to a requirement for full implementation of state mitigation programs; making the "trigger" threshold for assistance more stringent; and eliminating certain categories of disaster assistance and creating instead a public assistance loan program. Congress might also wish to review the criteria used by the President to declare disasters—we may not be able to afford to be so "generous" in the future as we have been in the past 5 years.

(3) Slight modifications in the U.S. Tax Code could have a major impact. We should eliminate or reduce tax benefits for coastal development such as the casualty-loss deduction and instead provide deductions for home improvements intended to mitigate storm damages or threatened property relocation. The U.S. Tax Code could also be revised to provide larger offsets for voluntary coastal setbacks and the establishment of wetland buffers to minimize impacts from sea-level rise. We should provide better tax incentives for granting of conservation easements on coastal beaches and wetlands.

(4) Congress should continue to increase its support of state and local coastal management programs. One step was taken with the 1990 amendments to the CZMA which specifically recognized the potential importance of climate change and sea-level rise and called for States to anticipate and plan for these events. Other ways to strengthen this program include: establishing a standard of minimum development controls which states must meet; requiring a coastal hazards management plan; expanding appropriations and directing other federal resources towards support for this program which works towards "acting locally"; and supporting state acquisition programs of high-hazards coastal areas.

(5) Significant subsidies to coastal development also have occurred through the shoreline-stabilization and beach-nourishment programs of the U.S. Army Corps of Engineers. Like many coastal States, the Federal government should discourage permanent shoreline stabilization where feasible. The Corps should be directed to develop a long-term management strategy that explicitly discourages such approaches. Congress should require greater State and local contributions toward renourishment projects in the short-term and move towards phase-out of federal funding of beach-renourishment projects. The only possible exception might be where federal structures such as groins and jetties can be demonstrated to be the cause of downdrift erosion. At a minimum, federal funding could be replaced with

a revolving-fund program similar to that used for sewage treatments plants under the Clean Water Act with loans made contingent upon adoption of certain State and local coastal management initiatives.

(6) With regard to protecting our valuable coastal wetland resources, existing programs such as Section 404 of the Clean Water Act could be strengthened to take into account future sea-level rise. We first need to minimize the current rate of loss, both in a real extent as well as functional capacities. In this regard, the "no-net-loss" policy is most significant—providing that we soon reach agreement regarding a viable definition for wetlands. Congress needs to encourage the expansion of Section 404 and strengthened enforcement of its provisions. Current exemptions allow for losses that may appear small on the face of each individual case but that have a large cumulative effect. And clearly, we need to eliminate federal subsidization of the destruction of wetlands: a good approach was begun with the Swampbuster program when crop subsidies and disaster payments were withheld on crop acreage if agricultural activities resulted in the destruction of wetlands. It is also very important to continue to fund and, indeed, expand funding for, wetland acquisition programs. These are important areas of the landscape that provide many benefits to society: acquisition is clearly the most cost-effective approach toward protection of these areas. NEPA, or its implementing regulations, should be amended to require that all future federal projects consider the effects of the proposed action on the water and sedimentation regimes that supply wetlands, both now and under climate change scenarios. There is also a pressing need to augment and coordinate monitoring of the functional capacities and a real extent of wetlands so that we have an idea of how we are doing.

(7) Finally, the Federal Government should join with the private sector, particularly the private insurance industry, to engage in a comprehensive public education program to increase awareness of risks to our shorelines and wetlands.

It is through the above recommendations that our nation can better prepare for an uncertain climate—now and in our changing future.

PREPARED STATEMENT OF THE SPECIALTY STEEL INDUSTRY OF THE UNITED STATES

Mr. Chairman and Members of the Subcommittee. The Clinton Administration recently unveiled its "Climate Change Action Plan" to attack the problem of global warming. Included in that plan is a provision calling for the use of a product called "amorphous metal" in the cores of electrical transformers. By specifying this single product, the provision ignores the fact that "Grain Oriented Electrical Steel" is actually the material of choice by most transformer manufacturers and electric utilities because of its generally superior performance. In addition, this provision prohibits any competitive efforts to achieve the goal of efficiency in transformer cores.

The plan can and should be broadened to call for use of high energy efficient transformers, which are also made from other materials, thus encouraging competition to reach this result.

While we strongly support increasing the energy efficiency of our nation's electrical distribution system, the efficiency increase must be accomplished in a cost-effective, pro-competitive manner. Specifying a particular product or technology precludes the search for and development of new products and technologies for future availability and undermines competition in the marketplace, which will harm an important sector of American industry. It is fundamentally unfair and wrong for the Administration to specify the use of one particular material over another in its plan.

While amorphous metal may be an acceptable material in some applications, another material—Grain Oriented Electrical Steel—is by far the most widely used high energy-efficient material for transformer cores. We believe that inclusion of the amorphous core endorsement in the plan was based on limited information provided by the sole manufacturer of amorphous metal and did not include an accurate or objective evaluation of the amorphous material, including its cost-performance relationship to competitive materials. That manufacturer has reportedly spent over $200 million in the past 20 years developing and trying to market its product, with little success thus far. Moreover, the possible adverse impact amorphous metal transformers could have on the environment was not considered by the Administration.

A more constructive approach would be to modify the proposal in the Climate Change Action Plan to call for the use of "high efficiency transformers" rather than specifying a particular material. That change would permit the competitive market to deliver the most cost-effective and energy-efficient material that would be best for the intended use.

What is Silicon Steel?

"Grain Oriented Electrical Steel" (silicon steel) is a flat-rolled 3 percent silicon iron alloy having outstanding electromagnetic properties. It is the material of choice for energy-efficient transformer cores by both transformer manufacturers and the electric utility industry. The cost-performance relationship of silicon steel is superior to that of amorphous metal.

Silicon steel has been on the market for many years and, through continuous research and development efforts, its energy efficiency in transformer cores has increased substantially—more than 15 percent since the early 1980s.

Silicon steels are manufactured by two modern, efficient and technologically advanced specialty steel companies in the United States as well as by other steel producing competitors elsewhere in the world. High technology manufacturing methods are employed in the production of these steels, including the use of space-age lasers to scribe the steels, which further enhances their energy efficiency. Silicon steel production accounts for thousands of jobs in the United States.

Why Silicon Steel Is Superior To Amorphous Metal In Most Applications

- Silicon steel core transformers are as efficient as amorphous metal core transformers.

98 percent or better core efficiency. Silicon steel core transformers have been on the market for many years. Through continuous research and development efforts, their energy efficiency has increased substantially—more than 15 percent since the early 1980s. In fact, distribution transformers made with silicon steel typically exceed 98 percent efficiency.

More efficient than amorphous metal transformers in some cases. Silicon steel transformers are more efficient than amorphous metal transformers in many circumstances. For example, amorphous metal transformers lose greater amounts of electricity in a loaded condition (while power is being drawn by consumers from the transformer) than do those made from silicon steel. The load losses of amorphous metal transformers may be equal to or greater than the energy savings realized during the same period from the no-load losses. Proponents of amorphous metal transformers tell only part of the story by considering efficiencies only during no-load conditions (when the transformer is not being used). Utilities should be allowed to choose either transformer, depending on whether efficiency can be improved more during load or no-load conditions.

Utilities select silicon steel transformers when considering total ownership. There is a well-accepted mechanism in place by which utilities cause transformer manufacturers to choose the most energy-efficient, cost-effective materials for transformer cores, by taking transformer losses (which determine efficiency) into account when making their transformer purchasing decisions. They calculate the present worth of their cost for the transformer losses over the transformer's lifetime and combine that value with the transformer's purchase price to obtain the "total ownership cost" of the transformer. This procedure takes into account all known environmental costs to the utilities such as scrubber installation costs, fuel cost, fuel transportation, etc. In this way, utilities optimize their transformer purchasing to obtain the lowest total ownership costs. This process leads to the selection of silicon steel in most applications.

- There is no demand or market for amorphous core transformers.

No market. Despite a decade of effort, the use of amorphous metal in transformer cores has not achieved commercial acceptance for sound technical and economic reasons. While it has gained acceptance in a few select applications, silicon steel transformers are, and continue to be, the material preferred by transformer producers and the utility industry. Because amorphous core transformers have been unable to gain a significant foothold in the transformer market, the producer is now attempting to "legislate" its acceptance.

Difficult to repair. Amorphous metal material is extremely brittle, thus making amorphous core transformers more difficult and costly to repair than silicon steel transformers.

Harms U.S. competitiveness abroad. Adoption of an exclusive amorphous core transformer policy would place the United States at an international disadvantage because these materials have proven unsatisfactory for transformer technology used in most countries of the world. Utilities in most countries continue to use and improve transformers utilizing silicon steel cores. Our ability to compete in the international market in terms of U.S. technology will be severely hampered if we abandon silicon steel transformers in this country.

Limited supply. There is only one dominant manufacturer of amorphous metal for distribution (wound core) transformers, with limited production capac-

ity. This manufacturer has invested heavily and perhaps unwisely in developing its technology. By government fiat, the firm is attempting to recoup an investment that has thus far been largely unsuccessful in the marketplace.

Unsuccessful applications of amorphous metals. There is no manufacturer of amorphous metal power (stacked core) transformers. All attempts to develop this technology for such transformers have been abandoned because of lack of success. Silicon steel is the material of choice for power transformers.

Expensive. The purchase price of an amorphous metal transformer is about 30 percent greater than that of an equivalent KVA size silicon steel transformer. This price premium is justified only for those few utilities who assign a very high value to no-load (or core) loss. Even when an amorphous metal transformer is justified, the break-even point is reached only after many years of operation.

- Exclusive endorsement of amorphous core transformers is inconsistent with other environmentally beneficial policies.

Not recyclable. Silicon steel is completely recyclable. Amorphous metal is not. Therefore, a preference for using amorphous metal is inconsistent with Congressional, White House, and EPA policies. The U.S. specialty steel industry is already one of the largest recyclers in the nation, recycling billions of pounds of scrap metal, including silicon steels, each year.

As Administrator Browner recently stated, "This Administration is committed to making pollution prevention the guiding principle of all our environmental efforts." Endorsing a technology that creates a nonrecyclable waste is not consistent with that principle. Exhibit 1.

Not multimedia oriented. Administrator Browner has stated, "We will incorporate multi-media prevention as the principle of first choice in all the mainstream activities of EPA. . . ." Endorsing a technology that is "good" for the air, but "bad" for the land (because it is not recyclable) is not consistent with this principle.

Undermines conservation measures endorsed in Acid Rain Program. The endorsement of this technology may be inconsistent with the EPA's support for both types of transformers as qualifying measures that may be included in a reduced utilization plan under the Acid Rain Program, 40 CFR § 72.43 (Appendix A to Subpart F).

- The public was excluded from the decision-making process.

The decision to exclusively promote one transformer technology has been made without any public debate, comment, or review. There have been no Congressional hearings on this subject. No executive agency has published this final decision for public comment or even sought input from interested parties. Consequently, knowledgeable and interested parties have not had a fair opportunity to present their views on this issue. Instead, the decision to promote a single manufacturer's product has been made behind closed doors for the benefit of a special interest.

The 1992 National Energy Policy Act calls for studies by the Department of Energy to determine ways of measuring efficiencies of distribution transformers. Endorsing one type before these studies have even been completed undermines DOE's responsibilities under the Act.

Conclusion: The Climate Change Action Plan Should Be Modified to Permit Competition to Determine the Material of Choice

Rather than selecting a single technology, the Administration's plan should be modified by deleting the reference to amorphous metals and allowing competition to determine the appropriate materials necessary to achieve energy efficiency goals. Specifically, Action Point 30 should be amended as indicated on the attached mark-up. Exhibit 2.

EXHIBIT 1—UTILITY TRANSFORMERS RECYCLING ISSUES

ALLIED SIGNAL'S AMORPHOUS METAL IS NOT RECYCLABLE AND ITS USE IS THEREFORE INCONSISTENT WITH CONGRESSIONAL, WHITE HOUSE AND EPA POLICY

Congressional Policies Encouraging Recycling

1. Pollution Prevention Act of 1990: "The Congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible: pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; and disposal or other

release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner." 42 U.S.C. § 13101(b).

2. Resource Conservation and Recovery Act ("RCRA"): An objective of RCRA is "minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly conducted recycling and reuse, and treatment." 42 U.S.C. § 6902(a)(6).

B. EPA Policies Encouraging Recycling

1. EPA 1989 National Policy/Plan on Pollution Prevention, 54 Fed. Reg. 3,845 (1989). To reduce solid waste, the EPA recommends the following hierarchy of options: (1) source reduction; (2) recycling; and (3) incineration and landfilling. EPA's national goal is to reduce and recycle 25 percent of municipal solid waste.

2. Current EPA projects encouraging recycling.

a. "Recycling Means Business" is a joint market development strategy for EPA and regional offices. This strategy identifies all EPA initiatives to enhance markets of recovered materials and recycle products.

b. Numerous public/private partnerships to stimulate the demand for recycled projects. Examples: EPA partnership with the National Recycling Coalition's "Buy-Recycled Business Alliance," targeting major corporations; EPA partnership with the U.S. Conference of Mayors' "Local Buy Recycled" project targeting local governments.

c. EPA projects to stimulate investment in recycling businesses: (1) two demonstration projects in major metropolitan areas to support local economic development and job creation through processing recovered materials and manufacturing recycled projects; and (2) partnership with the Economic Development Administration to produce workshops: teach financiers about recycling investment opportunities and teach recycling businesses bow to obtain financing.

C. White House Policies Encouraging Recycling

1. Executive Order 12873 on Federal Acquisition, Recycling and Waste Prevention. "Each Executive agency shall incorporate waste prevention and recycling in the agency's daily operations and work to increase and expand markets for recovered materials through greater Federal Government preference and demand for such products." 58 Fed. Reg. 54911 (October 22, 1993).

EXHIBIT 2—LAUNCH EPA ENERGY STAR TRANSFORMERS

Description. EPA will launch Energy Star Transformers, a partnership with electric utilities to invest in high efficiency transformers that reduce transformer losses. EPA will work with industry to establish minimum efficiency levels, where all qualifying equipment will be designated with the Energy Star logo. Participating utilities agree to purchase only Energy Star transformers, and to institute early replacement of transformers where economically warranted. EPA will distribute information regarding energy-efficient transformers to utilities and State Public Utility Commissions (PUCs), and help participating utilities to organize group purchases of energy-efficient transformers in order to obtain lower prices.

Implementation. Implementation is currently underway with industry stakeholder meetings. Manufacturer response has been highly positive. Additional resources will be allocated in 1994 and 1995 to gain greater program participation among utilities through sponsorship of additional program conferences and broad marketing initiatives. This action works in concert with the action to promulgate minimum efficiency standards for transformers, which will remove low efficiency transformers from the marketplace. The Administration is proposing to obligate $1 million in FY 1995 for this action and $3.5 million through 2000.

Market impact. Participating utilities will incur up-front incremental costs of 25–35 percent compared to regular transformers. This investment will pay off in approximately 7 years and then continue to pay off over the life of the transformer, which is more than 40 years. The cost differential will decline as the sales volumes increases, due to economies of scale in the production process. The costs will be incurred as utilities routinely replace their transformers (i.e., natural turnover), or undertake cost-effective early replacement. Under Energy Star Transformers, 3 million high efficiency transformers will be installed by 2000, with penetration rising from less than 5 percent of total installations in 1995 to nearly 100 percent of total installations in 2000. This action, together with the action to accelerate the development of efficiency standards for electric transformers, stimulates about $480 million in private sector investment for the period 1994–2000 (undiscounted 1991 dollars). This investment yields energy savings worth close to $280 million through 2000,

and continues to pay off over the next decade, for an additional savings worth close to $600 million over the period 2001–2010 (undiscounted 1991 dollars).

Emissions reduction. The emissions impact of this action was analyzed in combination with the action to accelerate the development of efficiency standards for electric transformers. Together, these actions reduce greenhouse gas emissions from projected 2000 levels by 0.8 MMT of carbon equivalent.

○

ISBN 0-16-044779-8